SERIES 800
LOGIC ANALYSIS SYSTEM

Operator's Manual

Nicolet
Nicolet Paratronics Corporation

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March 28, 1984

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NPC-864MSTWC
LOGIC ANALYSIS SYSTEM
OPERATOR'S MANUAL

** WARNING **

DO NOT REMOVE THE TOP COVER UNLESS THE AC LINE CORD IS FIRST UNPLUGGED.

BEFORE APPLYING POWER TO THE NPC-800, MAKE CERTAIN THAT THE PROGRAMMABLE AC VOLTAGE SELECTOR CARD, WHICH PLUGS INTO THE POWER MODULE AT THE REAR OF THE UNIT, IS INSERTED IN THE POSITION CORRESPONDING TO THE LINE VOLTAGE BEING USED; OTHERWISE, SERIOUS DAMAGE TO THE INTERNAL SWITCHING POWER SUPPLY MAY OCCUR.

SERVICE OF THIS INSTRUMENT SHOULD ONLY BE PERFORMED BY SKILLED MAINTENANCE PERSONNEL.

APPLICABLE DOCUMENTS:

CP/M[R] SOFTWARE DOCUMENTATION

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A NOTE ABOUT THIS MANUAL...

This Operator's Manual describes the NPC-848S, NPC-816T, NPC-864ST, and the NPC-864MSTWC Logic Analysis Systems. These systems represent the most common configurations of the available modules.

The operation of each analysis module is the same, no matter which system is being used.

Therefore, most examples in this manual will use the NPC-864MSTWC, which contains all available modules.

1.0 INTRODUCTION

The NPC-800 series is comprised of the following instruments: the NPC-848S, a lower-cost, forty-eight-channel, logic state analysis system ideal for general-purpose troubleshooting; the NPC-816T, a 16 channel logic timing analyzer which processes trigger events and collects data at up to 200 MHz; the NPC-864ST, a combination of the NPC-848S and NPC-816T; and the top-of-the-line NPC-864MSTC, a sixty-four-channel, disk-based, analyzer/computer/controller which can be used in all phases of a product's life-cycle: design, development, production test, and service. The NPC-848S, NPC-816T, and NPC-864ST can be modularly upgraded to the NPC-864MSTC at any time.

1.1 ELECTRONIC WORKBENCH

In order to simplify your overall engineering tasks, a comprehensive set of easy-to-use, ROM-based analysis tools are integrated in the NPC-800 series as shown below:

800 SERIES SYSTEMS

All NPC-800 Series Systems are Fully Expandable to the NPC-864MSTC

Logic Analyzer Model Number	Module Number (1) 800 Mainframe	(2) 800 Microcomputer	(3) 48 Channel State	(4) 16 Channel H.S. Timing	(5) Waveform	(6) Counter/ Timer	(7) Performance Analysis	System Price
NPC-848S	Standard	See Note 1	Standard	See Note 1	See Note 1	Optional	See Note 1	$ 9950
NPC-848SC	Standard	See Note 1	Standard	See Note 1	See Note 1	Standard	See Note 1	$10900
NPC-816T	Standard	See Note 1	See Note 1	Standard	Optional	See Note 1	See Note 1	$12500
NPC-816TW	Standard	See Note 1	See Note 1	Standard	Standard	See Note 1	See Note 1	$14350
NPC-864ST	Standard	See Note 1	Standard	Standard	Optional	Optional	See Note 1	$15635
NPC-864STC	Standard	See Note 1	Standard	Standard	Optional	Standard	See Note 1	$16585
NPC-864STW	Standard	See Note 1	Standard	Standard	Standard	Optional	See Note 1	$17485
NPC-864STWC	Standard	See Note 1	Standard	Standard	Standard	Standard	See Note 1	$18435
NPC 864MSTC	Standard	Standard	Standard	Standard	Optional	Standard	Standard	$19500
NPC-864MSTWC	Standard	Standard	Standard	Standard	Standard	Standard	Standard	$21350
Option Price	$6815	$2035	$3135	$5685	$1850	$950	$880	

Note 1: This Module is available in the appropriate Modular Expansion Package shown in the table below

These test functions, powerful in their own right, can be used individually or linked together for analyzing problems that cross the hardware and software boundaries in your system.

The NPC-864MSTC incorporates 48K of user-RAM and two double-sided, double-density, 5¼" floppy disk drives. This gives you full access to the instrument's internal CP/M[R]-based microcomputer for test storage, test automation, and general-purpose computational tasks which can include circuit analysis, simulation, and word processing. And since the NPC-864MSTC operates as a powerful, IEEE-488 controller, you can add GPIB test equipment for a fully-automated test set-up. The architecture of the NPC-864MSTC microcomputer is shown in Figure 1-1.

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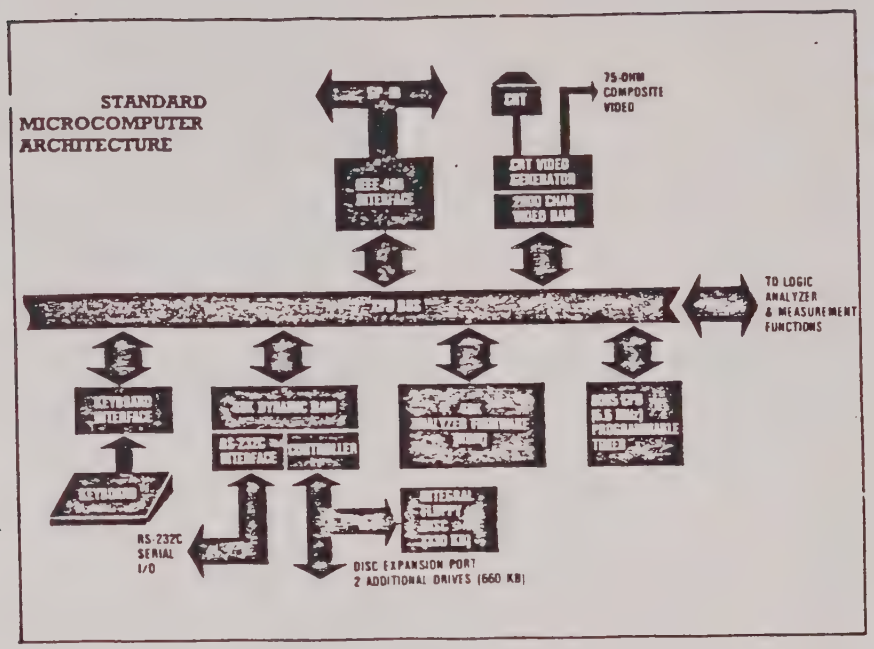

Figure 1-1. The architecture of the NPC-864MSTC microcomputer.

USER-FRIENDLY

From start-up, all NPC-800 series instruments are easy-to-operate even for the occasional user. Menus are organized in a natural and comfortable manner that take you quickly and simply through the desired test. Prompting messages, soft keys and labels, minimize the need to reference this manual.

Because all menus default to the most commonly-used parameters, simple problem-solving and meaningful data collections can be performed without any special set-ups. For example, when you're monitoring the operation of a microprocessor, all it takes is a single keystroke on the NPC-800 to see if your ADDRESS, DATA and STATUS signals are functioning properly.

RAPID SET-UP

When power is first applied to an NPC-800 series instrument, a Configuration List, (see figure 1-2), containing all available test and measurement modes, appears on a 9", 80-character by 25-line, CRT display. At the bottom of the display are labels for six software-directed (or "soft") keys which allow you to select the mode best suited to your current application. The function of each "soft" key changes each time the display changes, but the current function of each "soft" key is always shown at the bottom of the screen.

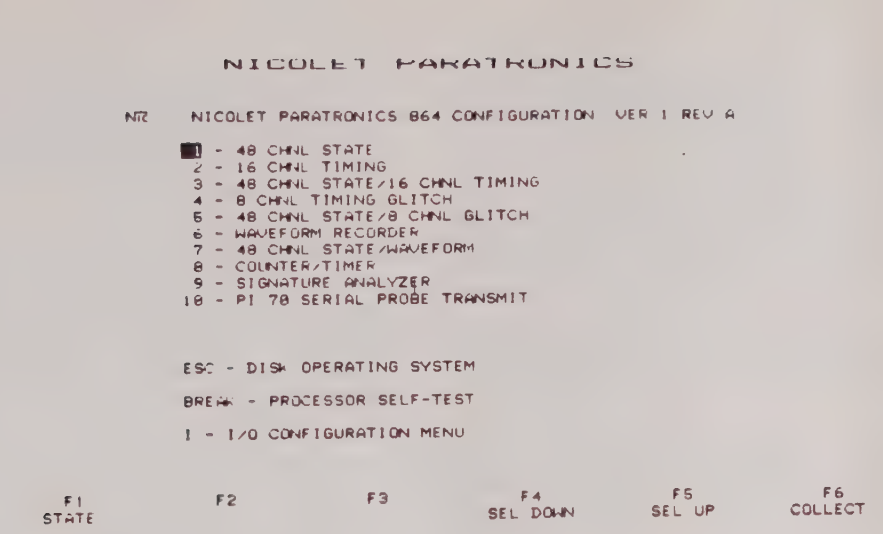
NICOLET PARATRONICS
NR NICOLET PARATRONICS 864 CONFIGURATION VER 1 REV A
1 - 48 CHNL STATE
2 - 16 CHNL TIMING
3 - 48 CHNL STATE/16 CHNL TIMING
4 - 8 CHNL TIMING GLITCH
5 - 48 CHNL STATE/8 CHNL GLITCH
6 - WAVEFORM RECORDER
7 - 48 CHNL STATE/WAVEFORM
8 - COUNTER/TIMER
9 - SIGNATURE ANALYZER
10 - PI 70 SERIAL PROBE TRANSMIT
ESC - DISK OPERATING SYSTEM
BREAK - PROCESSOR SELF-TEST
I - I/O CONFIGURATION MENU
F1 STATE
F2
F3
F4 SEL DOWN
F5 SEL UP
F6 COLLECT

Figure 1-2. Configuration Menu.

Once the desired mode is selected, the corresponding menu is displayed with its own set of soft-key labels. The soft keys allow you to access the menu fields so you can enter in test parameters from the ASCII keyboard. If an entry error occurs, a message appears on the CRT telling you which keys are valid for the current menu operation.

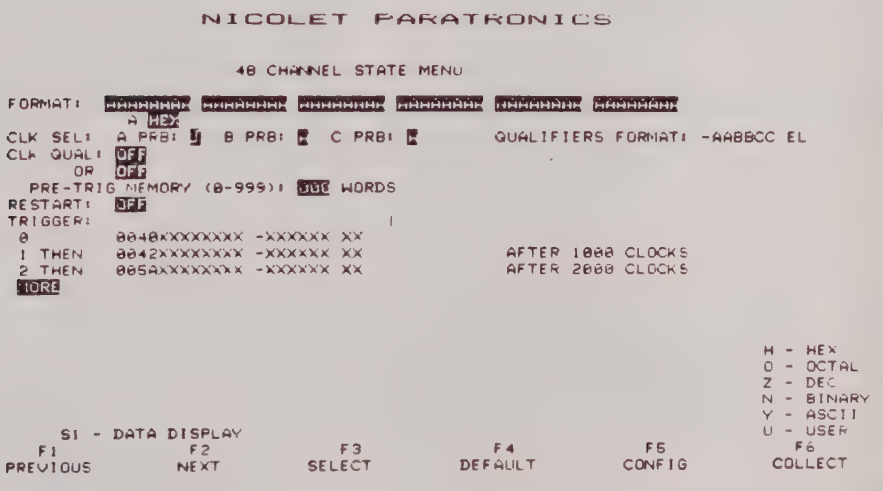

Figure 1-3. State Menu. Three of sixteen levels of triggering are shown.

Menu fields controlling advanced triggering modes can be turned off at any time, reducing your triggering set-up to a simpler form. In this manner, you can check that basic triggering conditions can be satisfied before activating the advanced set-up. This illustrates the time-saving, "start simple and build" philosophy behind the NPC-800 series: Advanced features do not get in the way of simple problem-solving--but they're available and readily accessible when you need them.

1.4 THE NPC-864MSTC FLOPPY DISK FOR TEST STORAGE

The two integral 5¼" floppy disk drives of the NPC-864MSTC can further reduce your test time. Simple commands allow you to store menu set-ups and test results. Later, these tests can be recalled and executed. A blank diskette can accommodate up to 50 individual tests.

Each stored test can incorporate comments, instructions, and other pertinent information. For example, in an engineering lab application, test comments could include: date of test, name of engineer, test or probing procedures, and remarks. On the production line or in the field, step-by-step procedures can accompany stored tests to increase the productivity of test personnel.

```
A>ED AUTOTEST.SUB

NEW FILE
     : *I
    1:  ;
    2:  ; TO THE OPERATOR:  YOU'RE GOING TO PERFORM 3 TESTS.
    3:  ; IT'S IMPORTANT THAT YOU FOLLOW THE INSTRUCTIONS CAREFULLY.
    4:  ;
    5:  ; STATE TEST:  AFTER READING THE INSTRUCTIONS BELOW, PRESS RETURN
    6:  ;              WHEN THE CURSOR FLASHES.  THIS WILL CALL THE STATE TEST.
    7:  ;
    8:  ;   A. CONNECT THE A STATE PROBE TO THE A SIDE OF THE TEST CARD.
    9:  ;   B. WHEN THE CONFIGURATION LIST APPEARS, PRESS THE COLLECT KEY.
   10:  ;   C. AFTER THE TEST IS COMPLETE, PRESS THE CONFIG KEY FOLLOWED BY THE
   11:  ;      ESC KEY TO RECEIVE INSTRUCTIONS FOR THE NEXT TEST.
   12:  ;
   13:  ; REMEMBER, PRESS RETURN WHEN THE CURSOR FLASHES.
   14:  PAUSE
   15:  LARECALL STATE
   16:  ;
   17:  ; TIMING TEST
   18:  ;
   19:  ;   A. CONNECT THE B TIMING PROBE TO THE B SIDE OF THE TEST CARD.
   20:  ;   B. WHEN THE CONFIGURATION LIST APPEARS, PRESS THE COLLECT KEY.
   21:  ;   C. AFTER THE TEST IS COMPLETE, PRESS THE CONFIG KEY FOLLOWED BY THE
   22:  ;      ESC KEY TO RECEIVE INSTRUCTIONS FOR THE NEXT TEST.
   23:  ;
   24:  PAUSE
   25:  LARECALL TIMING
   26:  ;
   27:  ; WAVEFORM TEST (OPTIONAL)
   28:  ;
   29:  ;   A. CONNECT THE SCOPE PROBE TO THE WF TESTPOINT ON THE TEST CARD.
   30:  ;   B. AFTER THE CONFIGURATION LIST APPEARS, PRESS THE COLLECT KEY.
   31:  ;   C. THIS COMPLETES THE TEST SERIES.
   32:  PAUSE
   33:  LARECALL WAVE
   34:
     : *E
```

Figure 1-4. Simple automated test program with operator prompts.

1.5 THE NPC-864MSTWC FOR TEST AUTOMATION AND GENERAL-PURPOSE COMPUTING

The NPC-864MSTWC System Block Diagram is shown in Figure 1-5.

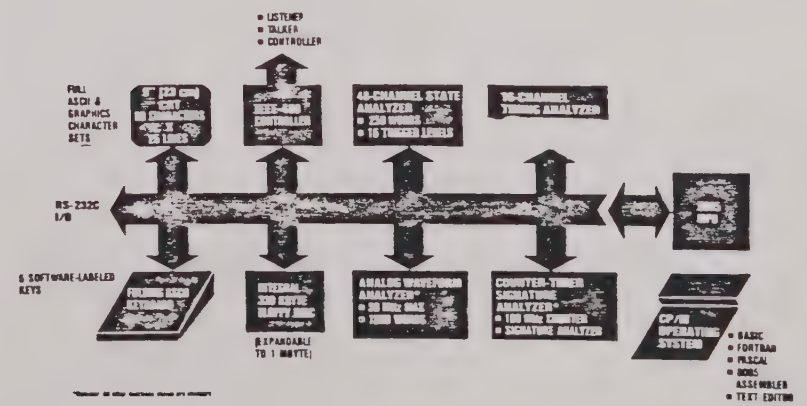

Figure 1-5. The bus structure of the NPC-864MSTWC.

In conjunction with its CP/M Operating System, the NPC-864MSTC's internal microcomputer allows you to:

- Automatically execute a series of stored tests using simple CP/M commands or the built-in GPIB CONTROLLER. Standard IEEE-488 commands in CBASIC permit the automation of internal test functions as well as the control of external GPIB instruments.
- Execute commercially-available CP/M application programs for solving engineering equations, circuit simulation, and report generation--even before hardware and software have been developed.
- Generate programs in CBASIC, FORTRAN, PASCAL, and other high-level-languages to support your particular application. CBASIC is included at no cost with your NPC-864MSTC.
- Construct a low-cost, universal development system. Commercially-available compilers and assemblers, in-circuit emulators, and a disk expansion chassis, add software development capabilities to the NPC-864MSTC.

1.6 THE NPC-800'S LOGIC STATE ANALYZER

Each NPC-848S, NPC-864ST, and NPC-864MSTC series analyzer incorporates a logic state section with some of the most powerful software debugging features available in the industry--features that are readily accessed through the ASCII keyboard. Upon initial selection, the state menu defaults to the most commonly-used parameters so you can collect meaningful data immediately.

When you need more debugging power, you can "build" on the basic state menu by calling up additional triggering levels, qualifiers, and other features. Operator prompts minimize your set-up time. A typical NPC-848S state menu is shown in Figure 1-6.

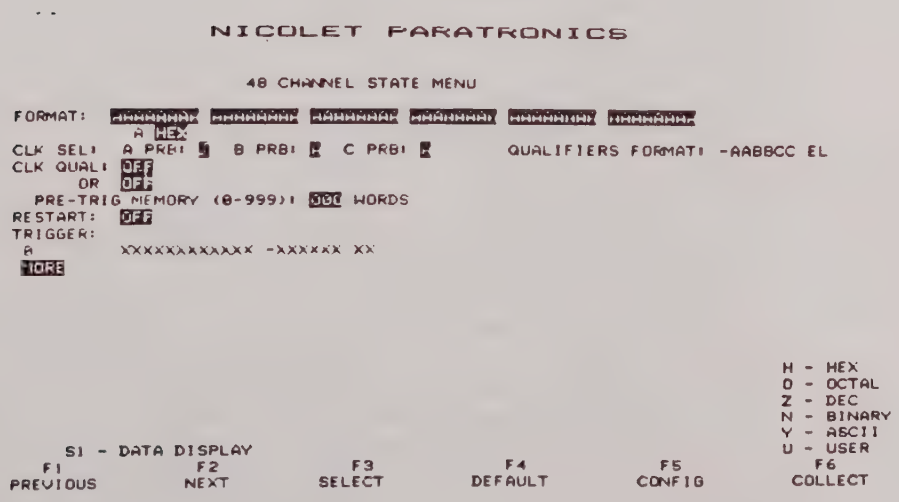

Figure 1-6. The NPC-848S state menu.

POWERFUL SOFTWARE ANALYSIS

The state analyzer section for the NPC-848S, NPC-864ST, and NPC-864MSTC is summarized below.

State Channels	Clock Qualifiers	Number of Clock Inputs	Main Memory Depth	Auxiliary Memory Depth	Trigger Levels	Pre-Triggering
48	Dual 55-Bit Wide	3	1000 Words	1000 Words	16	0-999 Words

These state analyzers allow you to collect ADDRESS, DATA, STATUS, or other synchronous occurrences from the digital portion of your system, at real-time rates up to 12.5 million events per second. And each instrument features menu-controlled linkage to internal or external test and measurement functions.

COLLECTING CLOCK QUALIFIED DATA

The NPC-800's clock qualification mode extends the trace capabilities of each state analyzer's 1000-word memory by restricting the data collection to specific events of interest. The clock qualification field in the state menu is partitioned into two sections: an internal clock qualifier field and an external field. See Figure 1-7.

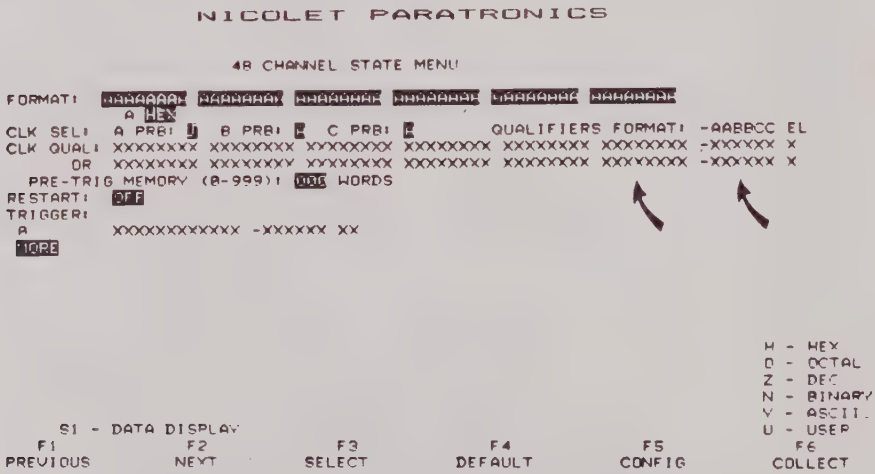

Figure 1-7. The clock qualifier field. (NPC-864 shown.)

The internal field is used to "self-qualify" the data coming into the analyzer from the probes. If a match occurs between the pattern set into the internal field and an incoming data word, then that data word is clocked into the memory. Since the internal clock qualifier field can be as wide as the maximum number of channels of the state analyzer, one application of this function is to collect data over a certain range of addresses or data words. This is accomplished by specifying, in the internal field, only the most significant address or data bits and leaving the remaining bits unspecified (don't care).

The external clock qualifier field uses separate lines (2 per 16-channel state probe plus 1 BNC input at the rear of the analyzer) to control the data collection. If one or more of the bits in the external field are set, the signals on the corresponding probe qualifier lines must match in order to clock data into the memory. A typical application is to use microprocessor status signals to restrict the data collection to memory, I/O or other operations of interest.

The clock qualifier fields for each NPC-800 state analyzer are partitioned as follows:

Internal Field	External Field		Total State Clock Qualifier Field
Data Probe Inputs	Data Probe Qualifiers	EXT BNC Connector	
48	6	1	55

1.6.3 MULTIPHASE CLOCKING

Multiphase clocking allows the data from the 16-channel state probes to be strobed into the analyzer at different times but displayed as if all incoming data were present simultaneously. For example, to simplify program tracing, an ADDRESS/DATA bus can be demultiplexed so that address and corresponding data words are displayed side-by-side.

1.6.4 MULTI-LEVEL TRIGGERING

For branch and subroutine analysis, all NPC-800 state analyzers offer multi-level triggering with auto or manual restart capabilities. Using the state menu, you can build up to 16 levels of sequential triggering to trace deeply-nested sections of your code. Like the clock qualifier function, the NPC-800's state triggering levels are each divided into an internal field and an external field. See Figure 1-8.

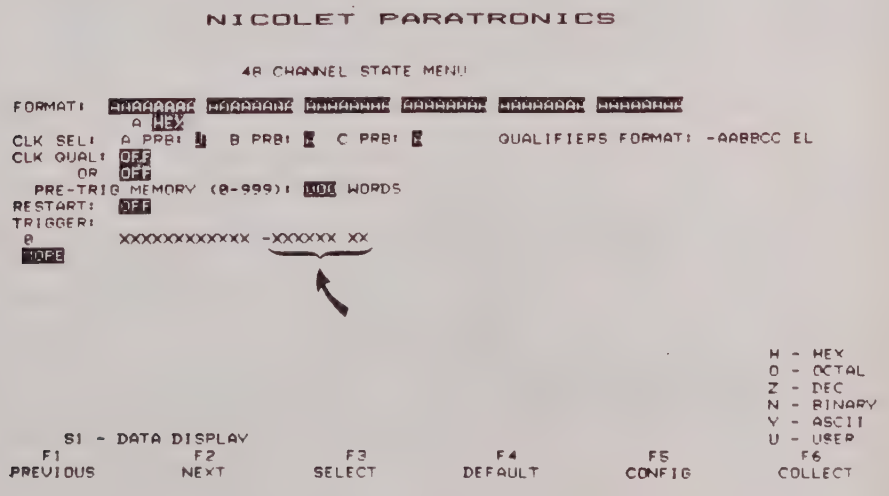

Figure 1-8. The trigger qualifier field.

For triggering to occur, the incoming data from the probes must match the pattern specified in the internal field at each trigger level.

The trigger fields for each NPC-800 state analyzer are partitioned as follows:

Internal Field	External Field			Total State Trigger Field
Data Probe Inputs	Data Probe Qualifiers	EXT BNC Connector	Linkage Bit	
48	6	1	1	56

The external **trigger qualifier** field utilizes the same probe and rear panel BNC control lines as the external **clock qualifier** field--plus 1 linkage bit. A typical application is to connect the microprocessor's branch status signal to a trigger qualifier line to enable triggering only when a jump instruction is executed. Another typical and powerful application is to use the linkage bit to trigger the state analyzer when commanded by the timing analyzer, the waveform analyzer, or any other test instrument—including another NPC logic analyzer model.

Further, at each trigger level, you can specify the time relationship of the current trigger word to the prior trigger word. For example, you can specify that the trigger word at the current level occur **precisely n clocks** after the word on the prior level. Other ways to characterize this time relationship include: **after n clocks, before n clocks, not on n clocks.** You can also specify that the current trigger word **occur n times** before the state analyzer will advance to the next level.

Each NPC-800 series state analyzer also incorporates an **AUTO-RESTART** feature which automatically resets the analyzer back to the first trigger level in the event that a user-specified triggering sequence is not completely satisfied. This situation can occur, for example, when an unexpected branch occurs during the sequence, so that subsequent triggering conditions are not satisfied. There is also a user-controlled **RESTART** function which allows you to specify a pattern in the state menu that will reset the analyzer's trigger stack when that pattern occurs in the incoming data.

In all, each NPC-800 state analyzer offers approximately 150 state triggering combinations which can handle virtually any software debugging requirement you're likely to encounter.

1.6.5 ADDITIONAL TIME-SAVING FEATURES

To further save analysis time, data can be specified in the state menu for display in any combination of hexadecimal, octal, decimal, binary, or ASCII characters. Displayed information can be grouped into as many as six different fields, with each field one or more bits wide. You can also blank one or more bits anywhere in the data field. Using optional disassembly software, microprocessor ADDRESS, DATA, and STATUS words are disassembled into an easy-to-read, mnemonic format.

For additional time-savings, all NPC-800 state analyzers display test codes that provide a quick, short-hand method of uniquely identifying your data collection. For each block of collected data, 16 bits wide by 1000 words deep, a 4-digit hexadecimal test code is computed by the analyzer using a data compression algorithm. Thus, two data collections can be quickly compared.

To further save time, you can put your NPC-800 to work overnight to detect and isolate hard-to-find, intermittent failures. Using the state auxiliary memory and a special triggering mode called **HOLD ≠**, you can compare a known good reference collection to unknown, incoming data. If the two collections match, the test is automatically repeated. If a difference is detected, the NPC-800 will display the faulty collection with all differences highlighted, ready for inspection when you arrive at work the next morning. And if you need to record the failure, a single command saves the test set-up and results on a diskette.

1.6.6 STATE ANALYSIS—ONLY ONE PART OF THE ELECTRONIC WORKBENCH

The debugging power of the state analyzer is further enhanced when used with the other test and measurement functions. For example, the state analyzer can be linked to the timing and waveform sections for cross-domain analysis; with the counter-timer/signature analyzer for system performance measurements; with the serial analyzer for debugging RS-232 interfaces; and with other, external instruments as part of a completely automatic test system.

1.7 THE NPC-800's INDEPENDENT TIMING ANALYZER

For hardware debugging, each NPC-816T, NPC-864ST and NPC-864MSTC series analyzer incorporates an independent timing analyzer with advanced triggering, data collection, and display capabilities. Like the state analyzer section, these capabilities, when initially selected, default to the most commonly used parameters so you can collect meaningful data with a minimum of keystrokes. For more in-depth hardware analysis, simple ASCII keyboard commands—coupled with operator prompts—reduce the time you'll need to invest in setting up complex tests. A typical NPC-800 timing menu is shown in Figure 1-9.

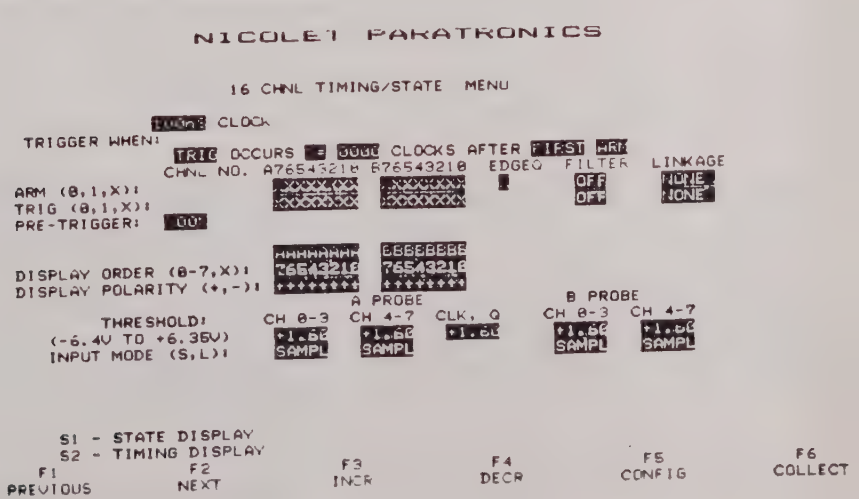

Figure 1-9. The NPC-800 timing menu.

1.7.1 POWERFUL HARDWARE ANALYSIS

The timing analyzer section for the NPC-816T, NPC-864ST, and NPC-864MSTC is summarized below.

Timing Channels	Max Sampling Rate	Main Memory Depth	Auxiliary Memory Depth	Glitch Capture	External Clock Input	External Clock Qualifier
16	200 MHz @ 16 ch;	1000 words @ 16 ch;	1000 words @ 16 ch;	YES	1	1

Like the state section, the NPC-800's timing analyzer can be linked to other internal or external test and measurement functions to trace hardware and software interactions in your system.

1.7.2 ADVANCED TRIGGERING

The optimum number of triggering levels for a timing analyzer is two: Only one level makes relatively routine timing measurements difficult; while more than two levels implies branch and subroutine tracing applications which are best performed by the state analyzer.

For this reason, the NPC-800's timing analyzer includes two levels of word recognition--ARM and TRIG. A **significant advantage offered by the NPC-800 series timing analyzer is that the TRIGGER EVENTS ARE PROCESSED AT UP TO 200 MHZ.**

When you use both trigger levels, three conditions must be satisfied before the timing analyzer will collect data: First, the ARM event must occur; second, the specified delay between ARM and TRIG must be satisfied; and finally, the TRIG event must occur.

Because of the large number of interactive signals in today's digital systems, it is necessary for a timing analyzer to provide the user flexibility in specifying the time relationship between the ARM and TRIG events. The NPC-800's timing analyzer accomplishes this through the following powerful delay modes:

- **TRIG occurs GREATER THAN nnnn clocks AFTER FIRST ARM**
- **TRIG occurs AFTER nnnn ARMS**

In the above modes, **GREATER THAN** can be changed to **LESS THAN** or **ON**; **AFTER** can be changed to **BEFORE**; **FIRST** can be **LAST**; **ARM** can be substituted for **ARM**; and **TRIG** for **TRIG**. The bar symbol over the ARM and TRIG words identifies the nonoccurrence triggering mode as described in the state section.

Thus, for example, if an expected TRIG event was not occurring exactly nnnn clocks after the ARM event had ended, you would simply use the following triggering mode to see what was really happening:

TRIG occurs ON nnnn clocks AFTER LAST ARM

In all, there are approximately 50 timing triggering combinations which can handle virtually any hardware debugging requirement you're likely to encounter.

If your problem is broader in nature, involving hardware-software or even digital-analog interactions, you can readily link the triggering of the timing analyzer to various combinations of state, waveform, or other, external measurement resources. For example, by linking the timing and state sections, you can observe and measure the performance of both the hardware interrupts and the associated software routines.

1.7.3 COMPLEX TIMING MEASUREMENTS MADE EASY

Because timing information is generally more difficult to analyze than state or analog information, a good timing analyzer should have extensive, yet easy-to-use, display manipulation capabilities. The display facilities of the NPC-800's timing analyzer have evolved through four generations of analysis instruments and provide one of the most useable presentations of timing information on the market.

For instance, when timing information is displayed, a moveable, inverse video graticule gives you an overview of the position and amount of data being displayed relative to the entire contents of the timing memory. See Figure 1-10.

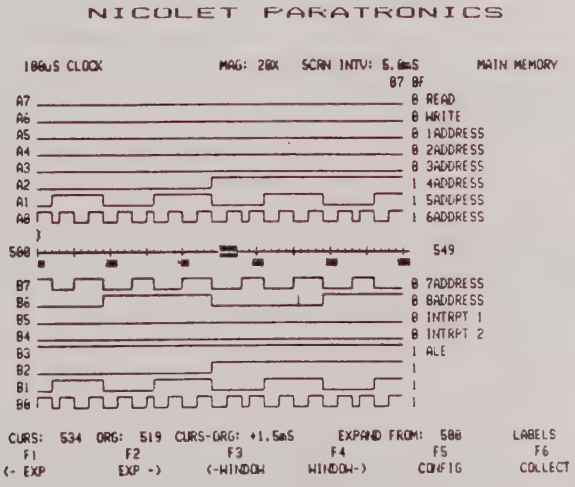

Figure 1-10. Typical NPC-800 timing display at 20X magnification.

Furthermore, all of the important timing parameters--sample rate, magnification factor (up to X20), screen interval, and the locations of the cursor and the origin--are all shown along with displayed data so you don't have to go back to the parameters in the menu to make sense of your timing measurements.

You can also name each channel with the 8-character label of your choice to make the display more meaningful.

If you need to rearrange the display order and polarity you don't have to adjust the probes; simply make the necessary changes in the timing menu. Probe input comparator thresholds are also ASCII keyboard selectable. A single keystroke gives you a state-equivalent display which can then be formatted in hexadecimal, octal, binary, decimal or ASCII.

1.7.4 COMPARISON TESTING

Like the state analyzer, the timing section has a separate, matching, auxiliary memory for comparing the current data collection with a known good reference. There is also a **CORRELATION** mode which tells you--on a channel-by-channel basis--how closely the main and auxiliary data collections match.

For example, if pulses are intermittently missing in a hardware sequencer, the data in the main and auxiliary memories will differ. Thus, the correlation factor for that particular channel will be low. A single keystroke selects a main/auxiliary memory comparison mode to automatically highlight those missing pulses.

If you'd like to have a permanent record of this and any other tests, along with the associated menu, simply save them on diskette.

1.7.5 HIGH SPEED COLLECTING

For higher-speed work, you can select the 200 MHz internal clock speed. The NPC-800 actually processes the ARM and TRIG events up to 200 MHz. Thus, you can trigger and collect 1000 samples at 5 nS intervals, increasing the probability of capturing and viewing those high-speed problems.

1.7.6 RECONFIGURE THE TIMING MEMORY

Another mode, called the **8-CHANNEL GLITCH**, partitions the 16-channel timing memory into an 8-channel glitch memory and a corresponding 8-channel data memory. This mode is used to display glitches as they occur in relationship to actual data.

1.8 THE NPC-800's WAVEFORM ANALYZER

In spite of the proliferation of digital systems, it's still an analog world and you still have to run down problems caused by analog signals. That's why NPC offers a plug-in, waveform analyzer option for the NPC-800 series.

The waveform analyzer plug-in provides cost-effective, high-speed, analog waveform recording which you can use to uncover problems due to analog and digital interactions in your system. Using a 6-bit A/D converter, analog signals are sampled at rates to 50 MHz, providing an effective 3 dB bandwidth of 10 MHz.

Each time a data collection is initiated, 1000 samples are stored. Displayed sample points are software-smoothed for readability.

POWERFUL ANALOG ANALYSIS

The waveform analyzer section is summarized below:

No. of Analog Channels	Max Sampling Rate	Main* Memory Depth	Auxiliary* Memory Depth	External Clock Input	Input Voltage Range	Pre-Triggering
1	50 MHz	1000 Samples	1000 Samples	1	5 mV/DIV to 200 V/DIV	0-1000 Samples

*The waveform analyzer uses the timing analyzer's main and auxiliary memories.

Like the state and timing analyzer sections, the waveform analyzer can be linked to other internal or external test and measurement functions.

1.8.1 SCOPE-TYPE MENU

The waveform menu is easy-to-use since it incorporates familiar, scope-like parameters. To record a waveform, select PROBE TYPE, (X1/X10), INPUT COUPLING, ATTENUATOR, DC OFFSET, TRIGGER LEVEL, and TRIGGER SLOPE. Next, select the free run or single shot mode and choose an appropriate sample rate, up to 50 MHz. See Figure 1-11.

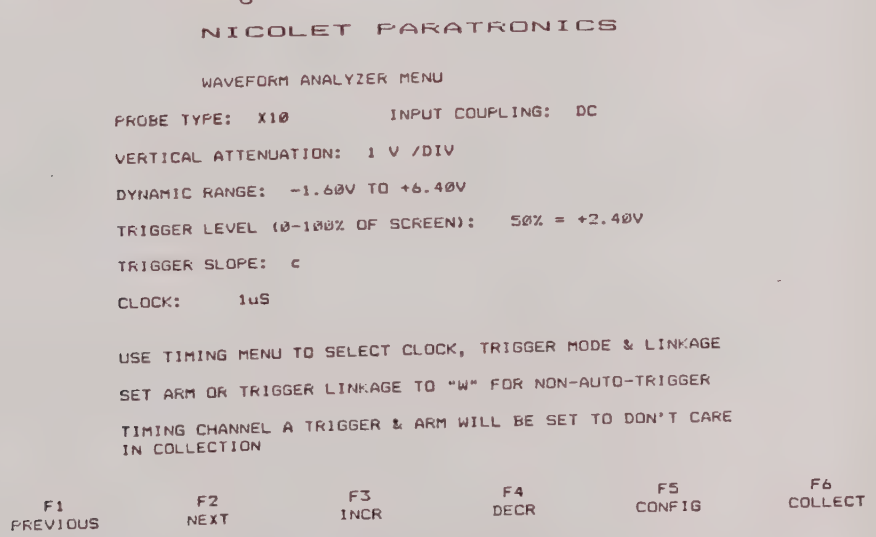
NICOLET PARATRONICS
WAVEFORM ANALYZER MENU
PROBE TYPE: X10
INPUT COUPLING: DC
VERTICAL ATTENUATION: 1 V /DIV
DYNAMIC RANGE: -1.60V TO +6.40V
TRIGGER LEVEL (0-100% OF SCREEN): 50% = +2.40V
TRIGGER SLOPE: ⊂
CLOCK: 1uS
USE TIMING MENU TO SELECT CLOCK, TRIGGER MODE & LINKAGE
SET ARM OR TRIGGER LINKAGE TO "W" FOR NON-AUTO-TRIGGER
TIMING CHANNEL A TRIGGER & ARM WILL BE SET TO DON'T CARE IN COLLECTION
F1 PREVIOUS
F2 NEXT
F3 INCR
F4 DECR
F5 CONFIG
F6 COLLECT

Figure 1-11. Typical NPC-800 Waveform menu.

When an incoming analog signal meets the threshold and slope requirements you've set into the menu, the waveform analyzer will trigger and collect 1000 samples. These samples are stored in the timing analyzer's memory and can be displayed in one of the following four formats: software-smoothed, raw sample points, software interpolated, or binary.

1.8.2 EASY ANALOG MEASUREMENTS

The waveform display format is similar to that of the timing analyzer. A moveable, inverse video graticule at the bottom of the CRT indicates the position and the amount of the waveform being displayed relative to the entire 1000-sample data collection. For closer inspection, any section of the waveform can be magnified up

to 20 times. Also, any point on the waveform can be selected as the origin so you can directly read instantaneous voltage and time values as you sweep the cursor across the screen. See Figure 1-12.

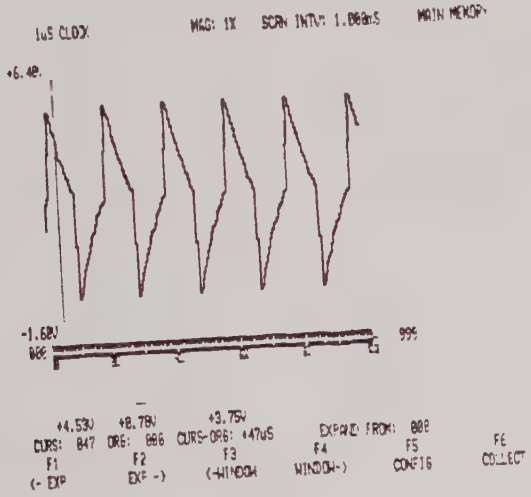

Figure 1-12. Typical Waveform display.

Like the state and timing analyzers, the waveform section allows you to store both the menu and a reference waveform for comparison testing. If you want permanent storage, the waveform and the associated menu can be transferred to diskette. You can even label the waveform for easy identification when the test is later recalled.

1.8.3 CROSS-DOMAIN ANALYSIS

Although the waveform analyzer is highly useful as a stand-alone tool, its enormous debugging power becomes apparent when you link it to the state or timing sections of the NPC-800. For example, when you need to closely examine the power-on characteristics of both the analog and digital portions of your system, you can set the waveform analyzer to trigger the state analyzer when the +5 volt power supply reaches a certain threshold. At this point, the NPC-800 will simultaneously collect both the +5 volt signal and the associated power-up subroutine.

As a second example, you can use the state analyzer to trigger the waveform analyzer upon the occurrence of an I/O address. The waveform analyzer could then be used to monitor the output signal at a serial port, while the state analyzer is collecting the associated I/O subroutine.

1.9 PERFORMANCE MONITORING

As hardware and software become more complex, the time your system takes to complete a given task becomes an important consideration. That's why the NPC-800's plug-in, counter-timer option is a useful performance monitoring tool during system test and integration.

9.1 USING THE COUNTER-TIMER PLUG-IN

The counter-timer offers you a choice of 4 different modes of operation: **FREQUENCY, PERIOD, INTERVAL,** and **TOTAL.** For stand-alone operation, a single, scope-type probe allows you to make conventional counter-timer measurements at various points in your system. See Figure 1-13.

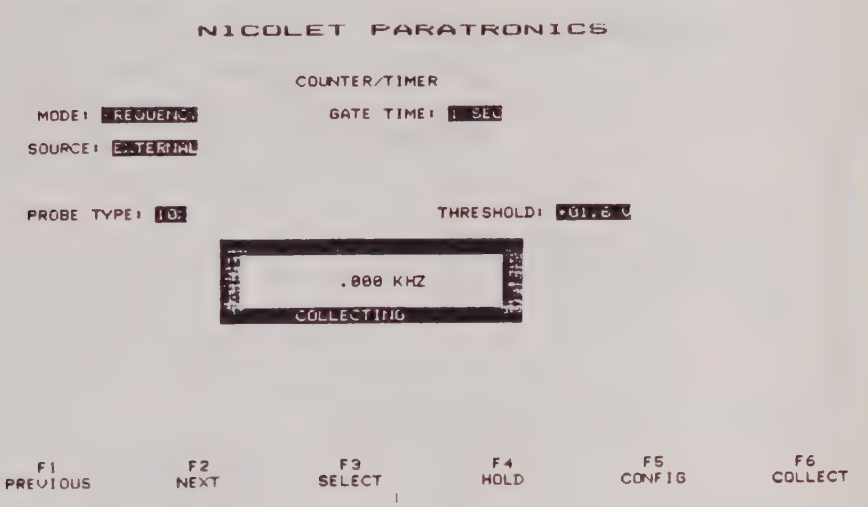

Figure 1-13. Typical Counter-Timer Menu.

However, for more complex measurements, particularly those involving performance monitoring, the counter-timer can be linked to the state analyzer's word recognizers, allowing measurements to be made on the data coming into the three 16-channel state probes. See Figure 1-14.

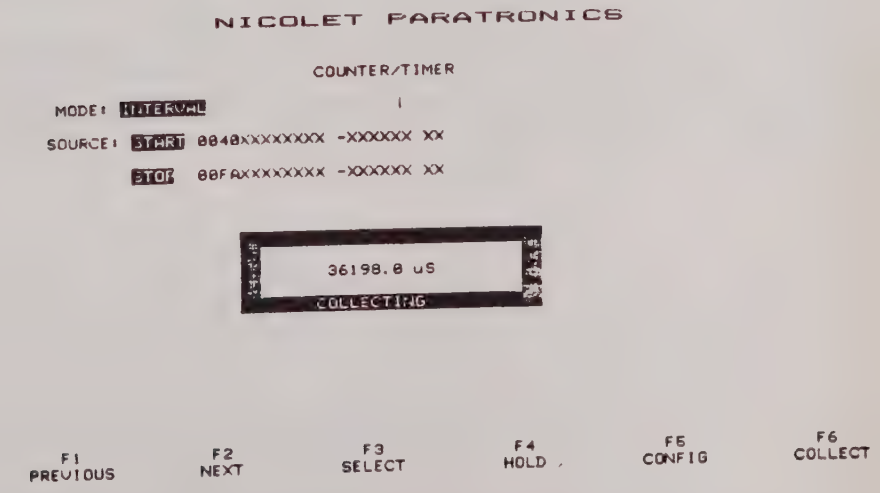

Figure 1-14. Measuring the interval between two state events.

Using this internal linkage mode, performance monitoring examples include: measuring the frequency of occurrence or average period of a subroutine; counting the total number of times a particular address or data word occurs during a program; and determining the time elapsed during the execution of a particular segment of code.

1.9.2 HISTOGRAMS

To provide the most cost-effective use of time spent analyzing system performance, NICOLET has provided software which gives a graphic presentation of statistical information collected from the target system under test. This graphic display, in bar chart format, allows a broad overview of the target system, using the hardware capabilities of the state analyzer or the counter-timer.

1.10 SIGNATURE ANALYSIS FOR FAULT ISOLATION

The signature analyzer resides on the same plug-in board as the counter-timer. And like the counter timer, the signature analyzer can be linked to the state analyzer's word recognizers. This enables the start and stop signals to be a minimum of one bit wide, just like conventional signature analyzers, or equal to the channel width of the state data probes.

With a one-bit start and stop signal, a single scope-type probe is used to monitor the serial data stream associated with each node in the circuit-under-test. This serial data stream, gated by the start and stop signal, is used to develop the 4-digit signature. See Figure 1-15.

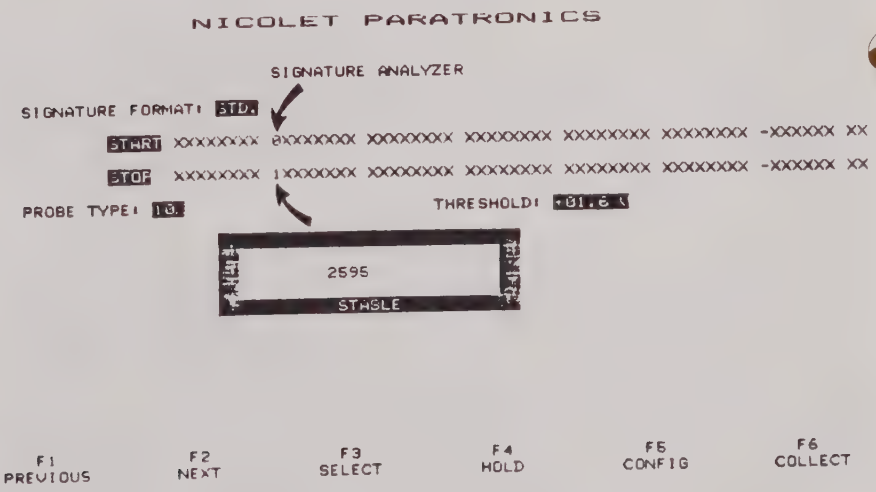

Figure 1-15. Simple 1-bit Signature Analyzer menu.

When the start and stop signal is more than one bit wide, you can develop signatures of more complex events. For example, if the start word were a subroutine call address and the stop word were a subroutine exit address, a unique signature of that subroutine would be developed by using the LSB of the address as the input serial data stream. In this manner, software bugs or revisions can be readily identified. See Figure 1-16.

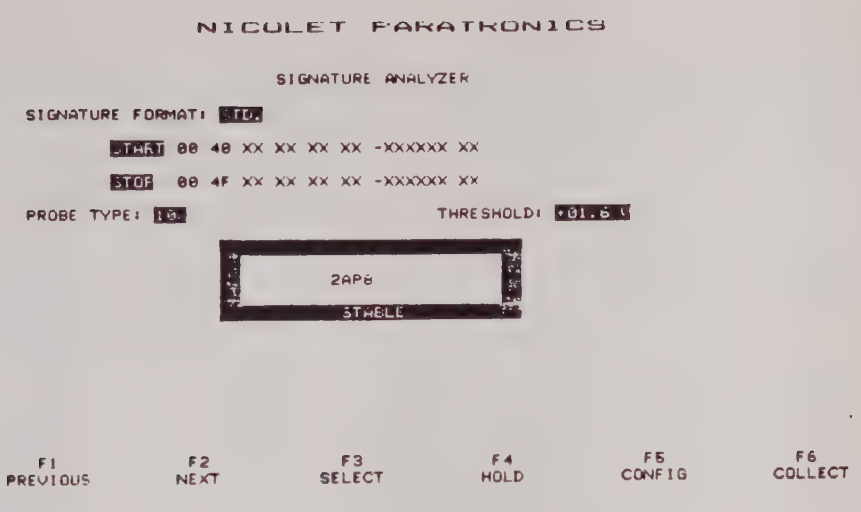

Figure 1-16. Signature Analyzer menu for developing software signatures.

In all cases, the algorithm used develops the same 4-digit signature as other industry-standard signature analyzers.

'.11 ACCESSORIES ENHANCE THE NPC-800

1.11.1 THE MODEL 70 FOR BIDIRECTIONAL SERIAL TESTING

In many applications, the ability to troubleshoot an RS-232 interface is an essential part of the system testing task. The Model 70 Serial Communications Probe offers you a cost-effective way of adding bidirectional serial testing capability to your NPC-848S, NPC-864ST or NPC-864MSTC. Simply insert the Model 70's TEE connector between your computer and its peripheral and use the NPC-800's state analyzer and Model 70 transmit menu to capture, analyze, edit and transmit serial information. See Figure 1-17.

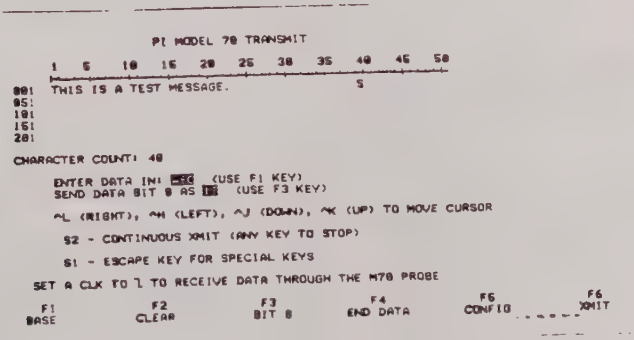
P1 MODEL 70 TRANSMIT
1 5 10 15 20 25 30 35 40 45 50
001 THIS IS A TEST MESSAGE.
051
101
151
201
CHARACTER COUNT: 40
ENTER DATA IN: ASC (USE F1 KEY)
SEND DATA BIT 8 AS 1 (USE F3 KEY)
^L (RIGHT), ^H (LEFT), ^J (DOWN), ^K (UP) TO MOVE CURSOR
S2 - CONTINUOUS XMIT (ANY KEY TO STOP)
S1 - ESCAPE KEY FOR SPECIAL KEYS
SET A CLK TO 1 TO RECEIVE DATA THROUGH THE M70 PROBE
F1 BASE
F2 CLEAR
F3 BIT 8
F4 END DATA
F5 CONFIG
F6 XMIT

Figure 1-17. The Model 70 Serial Transmit Menu.

LED's on the Model 70 Serial Probe provide a real-time indication of the activity on the RECEIVE, TRANSMIT, and STATUS pins. Baud rates from 50 to 19.2 Kbaud are switch-selectable on the probe. Other switches allow you to define pins 2 and 3 as RECEIVE or TRANSMIT, as well as define the number of stop bits, parity, and word length. See Figure 1-18.

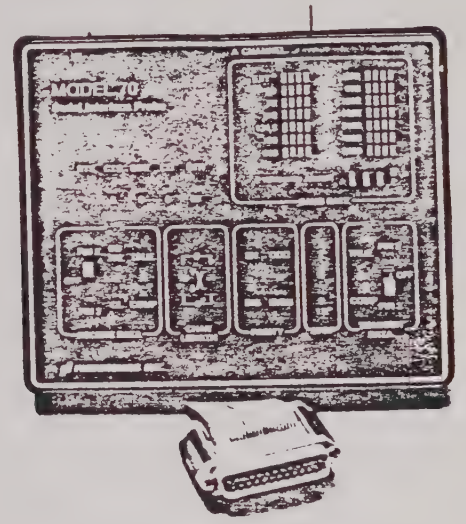

Figure 1-18. The Model 70 Serial Probe.

The Model 70 Serial Probe only requires 16 state channels. Therefore, there are 32 extra state channels--plus 16 timing channels and the other internal test functions--all of which are available to support additional measurements in your system.

As an example, let's assume you have a peripheral device that is not functioning properly. Is the problem in the computer, in the device, or in the interface itself? With the NPC-800/Model 70 combination, you have all the resources you need to rapidly isolate the problem. Use the RECEIVE and TRANSMIT modes to identify the computer, the peripheral, or the interface as the culprit. Then use the additional state, timing or waveform resources to isolate the underlying hardware or software fault.

1.11.2 DEDICATED MICRO-PROCESSOR PROBES SPEED SOFTWARE DEBUG

8-BIT AND 16-BIT DEDICATED PROBES FOR POPULAR MICRO-PROCESSORS

As the software used in system design grows, a logic analyzer and a dedicated probe with real-time disassembly capabilities become invaluable tools for analysis and debug. Real-time disassembly gives the user the ability to look at software execution at full system speeds. The data collected are then displayed in easy-to-read assembly language mnemonics.

1.11.2.1 QUICK CONNECTION

Using a pre-wired IC clip, each dedicated probe offers quick reliable connection to the microprocessor-under-test. A low profile "piggy-back" socket is also available for applications where space is at a premium.

All necessary signals for clocking data into the NPC-848S, NPC-864ST, or NPC-864MSTC are automatically generated by circuitry inside the probe. The data collection usually includes address, data, and control and status lines. One example of a dedicated probe is shown in Figure 1-19.

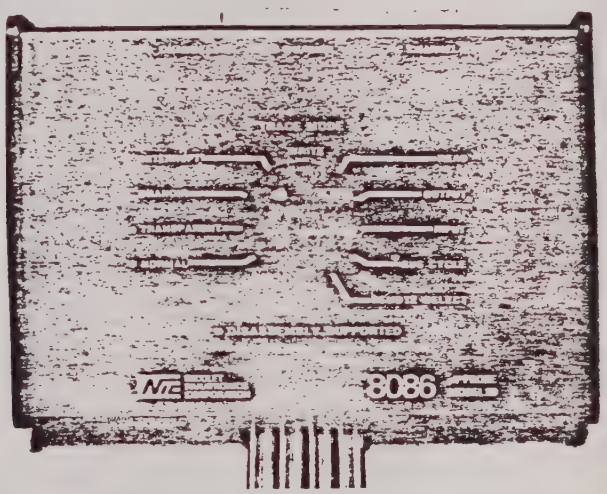

Figure 1-19. The dedicated probe for the 8086.

1.11.2.2 POWERFUL ANALYSIS CAPABILITIES

Used in conjunction with the dedicated probes, the NPC-800 powerful clock and trigger qualifiers can greatly simplify the analysis of your program's execution. With these qualifiers you can collect specific MPU operations or a combination of operations from among the following: MEMORY READ/WRITE, I/O, OPCODE FETCH, MPU STACK READ/WRITE, and BRANCHES. See Figure 1-20.

```
MAIN

LOC: TRIG

SIG: E3D7
     36E5
     D8D3

TRIG  0000      F3    OPCODE FETCH(TAIL)
+001  0000      FF    REFRESH
+002  0001  JP        0040H
+003  0001      FF    REFRESH
+004  0002      40    OPERAND FETCH
+005  0003      00    OPERAND FETCH
+006  0040  LD        SP,23FDH
+007  0002      FF    REFRESH
+008  0041      FC    OPERAND FETCH
+009  0042      23    OPERAND FETCH
+010  0043  LD        IY,00A0H
+011  0003      FF    REFRESH
+012  0044      21    OPCODE FETCH(TAIL)
+013  0004      FF    REFRESH
+014  0045      A0    OPERAND FETCH
+015  0046      00    OPERAND FETCH
+016  0047  SET       7,(IY+55H)
+017  0005      FF    REFRESH
+018  0048      CB    OPCODE FETCH(INCOMPLETE)
+019  0006      FF    REFRESH
+020  0049      55    OPERAND FETCH
+021  004A      FE    OPCODE FETCH(TAIL)
+022  00F5      21    DATA READ
```

Figure 1-20. Typical disassembly example.

Also, unwanted microprocessor activities, such as WAIT states and REFRESH cycles, can be purged from the data collection. Once set up, all modes are switch-selectable at the probe and require no further changes to the NPC-800's menu. Additional software analysis capabilities include triggering on one operation, such as a BRANCH, and collecting a different operation such as memory READS.

All of the NPC-800's 8-bit and 16-bit dedicated probes allow true, real-time disassembly of the instructions being executed in relation to the actual operands and memory addresses being generated. Furthermore, NPC's dedicated probes do not interfere with the real-time operation of the target MPU.

1.11.2.3 ADVANCED ANALYSIS CAPABILITIES

NPC's dedicated probes require 32 to 48 state channels depending on the probe type. As shown below, this leaves the remaining channels and test functions for an in-depth analysis of events on or off the microprocessor bus:

Dedicated Probe Type*	Channels Required by Probe	Logic Analysis Channels Remaining
8080, 8085, Z80, 6809E, 6800, 6802	32 State	16 Timing plus 16 State
8086 8088 68000	48 State	16 Timing

For example, let's say you're using the timing section to monitor a hardware interrupt subsystem and the state section to monitor the MPU. By linking the two sections, you can capture the interrupts while simultaneously disassembling the associated interrupt handling subroutine.

* Contact Nicolet Paratronics Corporation for the availability of dedicated probes not listed.

1.11.3 GENERAL PURPOSE PROBES SIMPLIFY INTERCONNECTION

Each NPC-800 is supplied with a complete set of probes and terminators. Three probe types are available: the Model 51A, the Model 81 and the Model 87. Each Model 51A accommodates 16 state channels, two qualifiers and an external clock. Each Model 81 probe accommodates 8 timing channels, 1 qualifier and a clock. The Model 87, which is actually a set of 5 dual-channel probes, is offered as an alternative to the Model 81. Whereas the Model 81 is perfectly suitable for monitoring signals that are physically in the same general area of your system, the Model 87 is ideal for the analysis of large systems where monitoring points can be as far as 8 feet apart. See Figures 1-21 and 1-22.

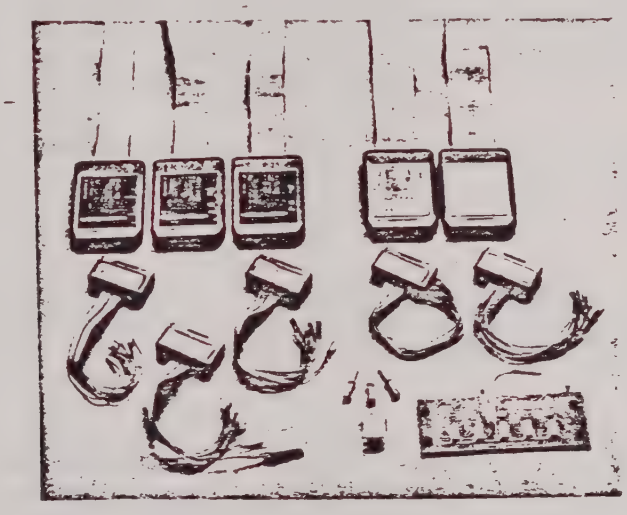

Figure 1-21. Standard probes and accessories.

Figure 1-22. Optional Model 87 probe set. (Replaces Model 81.)

When the optional test and measurement functions are installed, such as the waveform and counter timer/signature analyzers, a Model 90 X1/X10 probe is provided.

For all probes, compatible terminators are included which are color-coded and labeled for easy identification. The state and timing probe terminators interface with IC clips, wire-wrap pins, and spring-loaded miniature grabbers.

A summary of the general-purpose probes available with each NPC-800 analysis system is provided below:

State Analyzer	Timing Analyzer	Waveform Analyzer	Counter-Timer/ Signature Analyzer
3 ea. Model 51A	2 ea. Model 81A or 2 ea. Model 87*	1 ea. Model 90	Same as Waveform Analyzer

1.12 THE NPC-864MSTC AS A GENERAL-PURPOSE COMPUTER

The NPC-864MSTC departs from conventional test equipment by giving you full access to its internal microcomputer for automatic control, test storage, post-processing, and general-purpose computing applications.

The NPC-864MSTC uses an 8085 CPU and two operating systems: one operating system is in ROM and supports all test and measurement functions; the other operating system, CP/M, resides on disk and supports all computer-related activities. The two operating systems are designed to interact during automatic testing, test storage, and post-processing of collected data.

1.12.1 THE NPC-864MSTC'S ARCHITECTURE

The NPC-864MSTC incorporates a bus-oriented microcomputer architecture. The internal 8085 CPU, the CRT, the keyboard, the memory and I/O subsystems, as well as the logic analyzer and other measurement functions, all interface to the CPU bus as shown in Figure 1-1.

Since the analyzer's control programs are contained in 48K of ROM, all test and measurement functions are totally independent of the CP/M operating system and the disk drive.

On the other hand, all general-purpose computing tasks use the integral disk drive and the CP/M operating system as the primary interface. As shown in the figure, programs are downloaded into 48K of user RAM for execution. It's important to note that this user RAM is separate from the real-time data acquisition memories associated with the state and timing analyzers.

*The Model 87 is optional and consists of five, 5-foot long, dual-channel timing probes for the analysis of large systems.

Each of the two integral floppy disk drives use a 5¼", double-sided, double-density, soft-sectored, 96 TPI diskette, with 660 Kbytes of formatted capacity. There is a connector at the rear of the NPC-864MSTC which allows you to expand the disk memory system using an external, dual-drive expansion chassis.

The 9" CRT display is memory-mapped and uses an 80-character by 25-line format. A 256-character display generator provides full ASCII and graphics character sets.

1.12.2 CP/M ENHANCES THE NPC-864MSTC'S USEFULNESS

CP/M was chosen for the NPC-864MSTC since it is the single most commonly used operating system. There are hundreds of reasonably priced applications programs on the market offering higher level languages, engineering and scientific packages--even word processing.

Through CP/M, the user can also generate his or her own programs. These programs can be written in assembly language; or using a high-level-language such as CBASIC*, FORTRAN, PASCAL, PL/1--to name a few.

A printer driver program is available that enables the NPC-864MSTC to provide both text and graphics hardcopy on an Epson MX-80A printer. (Many of the illustrations in this Section 1.0 were derived using this program.)

1.12.3 POST-PROCESSING ANALYZER DATA

Prior to the NPC-764 and NPC-864MSTC, the logic analyzer user had to be satisfied with whatever data manipulation and display modes the manufacturer provided. However, through CP/M, post-processing programs can be written to support special applications. These programs can be generated in assembly language, CBASIC, or other languages.

As a simple example, an applications program can be written to transfer previously collected data between the NPC-864MSTC's state and timing sections. In this manner, you can display data collected by the state analyzer in a timing diagram format; or you can display state and timing data side-by-side on the same screen in the state format of your choice. Other post-processing examples include: searching for certain patterns or sequences in the data collection, generating custom or non-standard data displays such as histograms, and implementing special algorithms such as computing the Fourier transform of a previously-digitized analog waveform.

The commands that allow the transferring of data between the various analyzer memories and the 48K of user RAM are an integral part of the standard, NPC-864MSTC I/O software described in the following pages. Besides allowing the manipulation of data within the NPC-864MSTC, these commands also enable you to transfer normal or post-processed data to external GPIB or RS-232 devices.

*CBASIC is included with each NPC-864MSTC.

1.12.4 THE NPC-864MSTC AS A LOW-COST DEVELOPMENT SYSTEM

During the hardware and software integration phase of a project, a logic analyzer can be indispensable for uncovering subtle bugs. If the bugs are hardware-related, they can generally be fixed on the spot. However, if they are software-related, you may have to save up (and work around) enough bugs to make it worthwhile to halt the integration process and go back to the main development system to generate corrected code.

By adding a stand-alone emulator and a PROM programmer to your NPC-864MSTC, software bugs, too, can be fixed as they occur. This can be a more efficient and effective way of performing software integration since the debugging process can proceed without the delays often associated with having to access the main development system. Both the emulator and the PROM programmer interface to the NPC-864MSTC's RS-232 port.

With the above set-up, software changes can be quickly implemented and tested in your system. When the changes are proved to be successful, new PROMs can be programmed.

1.12.5 AUTOMATED TESTING AND REMOTE CONTROL

A unique I/O software package allows the NPC-864MSTC to be a central part of a powerful, IEEE-488 automated test system. This same software, which is standard on all NPC-864MSTC's, permits RS-232 MASTER/SLAVE operation in remote control applications. Additionally, the I/O software allows you to readily place the NPC-864MSTC under the control of another computer.

1.12.5.1 SINGLE I/O MENU SPEEDS GPIB AND RS-232 SET-UPS

The I/O software is an integral part of the ROM-based test and measurement operating system and does not require the CP/M operating system during manual operation. The associated I/O CONFIGURATION MENU incorporates all of the fields necessary to manually set up the NPC-864MSTC for GPIB and RS-232 operation. The menu consists of 4 quadrants: GPIB, RS-232, INPUTS, and OUTPUTS. See Figure 1-23.

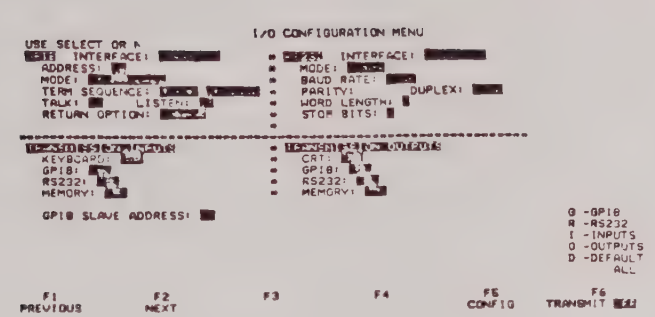

Figure 1-23. I/O CONFIGURATION MENU.

On the GPIB quadrant of the I/O CONFIGURATION MENU, the NPC-864MSTC can be set up as a CONTROLLER or a LISTENER/TALKER. On the RS-232 quadrant the instrument can be a MASTER or a SLAVE. In the TRANSMISSION INPUTS quadrant, data can come from the keyboard, from the GPIB or RS-232 ports, or from various analyzer memories. Then, using the TRANSMISSION OUTPUTS quadrant, you can send data to the CRT, to the various analyzer data memories, or out the GPIB or RS-232 ports. As a simple example of the use of the I/O CONFIGURATION MENU, consider an automatic test application that first required the manual excercising of an RS-232 or a GPIB device before running it under program control. By defining the NPC-864MSTC's keyboard as the data input, and the NPC-864MSTC's CRT as the output from the device under test, you can rapidly verify the integrity of your set-up.

1.12.5.2 GPIB CONTROLLER/ DEVICE APPLICATIONS

When the NPC-864MSTC is the central part of a GPIB-based, automated test system, the CP/M operating system, hosting CBASIC, is employed. Typical GPIB commands are:

ABORT	REQUEST	LOCAL LOCKOUT
GPIB	OUTPUT	CONFIGURE
RESET	ENTER	EOI STATUS
REMOTE	STATUS	SENDBUS
LOCAL	SET TIMEOUT	TERM SEQ
TRIGGER		

When using these commands, it's important to note that the NPC-864MSTC's internal test and measurement functions respond as if they were external devices on the GPIB bus.

Thus, you can add a pattern generator, a DVM, a power supply, and other GPIB-compatible instruments to the NPC-864MSTC and use the same command set for both internal and external functions.

If you already have an IEEE-488 controller, you can incorporate the NPC-864MSTC into your GPIB test set-up as a powerful, LISTENER/TALKER. In this configuration, the NPC-864MSTC will respond to standard GPIB commands from your controller, execute the required test, and transfer the results back.

1.12.5.3 RS-232 MASTER/SLAVE APPLICATIONS

One new application area that is showing considerable promise is remote diagnosis. Using an ordinary terminal and a telephone line, a factory specialist can remotely control the entire operation of an NPC-864MSTC. To avoid having to set up another communications link between the local and remote locations, any message typed at one location will appear on the CRT at the other location.

If the ordinary terminal is replaced by an intelligent terminal or a computer, then the NPC-864MSTC's functions can be fully automated. In this application, a test can be downloaded to the NPC-864MSTC and the results sent back to the intelligent terminal or computer for processing.

A third possible I/O configuration involves using one NPC-864MSTC as a MASTER and a second NPC-864MSTC as a SLAVE. Here, the NPC-864 functioning as the MASTER can execute a test on System A while the SLAVE NPC-864MSTC, following the commands of the MASTER, is running a test on System B. The MASTER can then command the SLAVE to report its test results. (One of the example program provided with your NPC-864MSTC actually performs this MASTER/SLAVE application.)

1.13 SUMMARY: THE NPC-800 ELECTRONIC WORKBENCH

The table below summarizes how the NPC-800 performs test and measurement tasks previously requiring a bench full of sophisticated and expensive test gear.

Table 1-1. The NPC-800 Electronic Workbench.

		STATE ANALYZER	TIMING ANALYZER	SERIAL ANALYZER	WAVEFORM ANALYZER
INPUTS:	NPC-764:	48 DATA, 3 CLOCKS, 9 QUALIFIERS	16 DATA, CLOCK, QUALIFIER	8 DATA, 8 CONTROL	SINGLE CHANNEL (10 uV/DIV. to 20 V/DIV.)
	NPC-748:	32 DATA, 2 CLOCKS, 6 QUALIFIERS			
MAX. DATA RATES		12.5 MHz	100 MHz (8 CHANNELS)	19.2K BAUD RECEIVE/TRANSMIT	50 MHz (6 BIT A/D)
MAX. REAL-TIME MEMORY DEPTH		1000 WORDS	2000 WORDS	1000 CHARACTERS	1000 SAMPLES
MAX. AUX. MEMORY DEPTH		1000 WORDS	2000 WORDS	1000 CHARACTERS	1000 SAMPLES
TRIGGER LEVELS		16	2	16	0%-100%; POS. SLOPE, NEG. SLOPE
DELAYS		AFTER N CLOCKS, NOT ON N CLOCKS, BEFORE N CLOCKS, ON N CLOCKS, OCCURS N TIMES: 0 N 9,999			USES TIMING ANALYZER TRIGGERING/ DELAY CIRCUIT
MAX. PRETRIGGER		999 WORDS	1800 WORDS	999 CHARACTERS	900 SAMPLES
DISPLAY		HEX, OCT, DECIMAL, BINARY, ASCII IN ANY MIX	16 TIMING; HEX, OCT, DECIMAL, BINARY, ASCII	CHARACTERS--ASCII; CONTROL--BINARY, HEX, ETC.	ANALOG WAVEFORM, (SOFTWARE SMOOTHED OR UNSMOOTHED)
LINKAGES		STATE TO TIMING, WAVEFORM	TIMING TO STATE, SERIAL, WAVEFORM	SERIAL TO TIMING, WAVEFORM	WAVEFORM TO TIMING, SERIAL, STATE

COUNTER/TIMER	
MODES	FREQ., PERIOD, TOTAL, INTERVAL
MAX. INPUT FREQ.	100 MHz
INPUT SOURCES	SCOPE PROBE (1X/10X) OR STATE ANALYZER WORD RECOGNIZERS

	SIGNATURE ANALYZER
FORMATS	HP AND HEX
INPUT	SCOPE PROBE (1X/10X)
GATE	STATE ANALYZER WORD RECOGNIZERS

I/O AND COMPUTING FACILITIES*		
IEEE-488	DEVICE	CONTROLLER
RS-232	SLAVE	MASTER
CP/M	T&M PROCESSING	GENERAL-PURPOSE COMPUTER

*THE NPC-764 INCORPORATES FULL I/O AND COMPUTING FACILITIES; WHILE THE NPC-748 INCORPORATES IEEE-488 DEVICE FUNCTIONS ONLY.

The following pages provide the details associated with each test function. If you have any questions or comments please contact our Applications Engineering Department.

Our Applications Engineers are available 8:00AM to 5:30PM daily. Ron Freund and Bob Brians may be reached via our NICOLET PARATRONICS HOTLINE. The number is 800/NIC-OLET. In addition, John Collins is our Applications Engineer located on the East Coast. He may be reached at 617/664-0124.

2.0 PREPARATION FOR USE

2.1 INCOMING INSPECTION

Look for obvious shipping damage such as dents or punctures. Also, check for loose PC boards, IC's, or other components.

NOTE: If shipping damage has occurred, **SAVE THE ORIGINAL CONTAINER** and notify the shipper immediately.

2.1.1 BASIC EQUIPMENT

The following items form the basis of every shipment:

1. **NPC-800 Logic Analysis System:**

   Includes accessory case and handle.

2. **Probes:**

   Each state and timing analyzer has the following probes as standard:

   (a) State Analyzer: 3 each Model 51A state probes, 16-channel variable threshold state probes.

   (b) Timing Analyzer: 2 each Model 81A timing/state probes, 8-channel variable threshold timing probes.

3. **Probe Terminators:**

   For connection to the system-under-test. The following probe terminators are standard:

   (a) Model 52-1: 1 provided with each Model 51A probe.

   (b) Model 82-1: 1 provided with each Model 81A probe.

   (c) **Model 83-1:** 1 provided with each Model 81A probe.

   NOTE: A package of 30 "ball clips" are included with the terminators.

4. **Miscellaneous Items:**

   - o 3-Wire Line Cord
   - o Logic Analyzer Test Card
   - o Operator's Manual
   - o CP/M Software Documentation (NPC-864MSTWC only)
   - o CP/M Diskettes (2) (NPC-864MSTWC only)

2.1.2 OPTIONAL EQUIPMENT

1. **Optional Probes:**

   (a) Model 87 High-Performance Timing Probe Set. High input impedance, high-speed hybrid probes useful for making timing measurements on circuit elements up to 8 feet apart.

(b) Model 70 Serial Interface Probe. For testing RS-232C/TTY interfaces.

(c) Dedicated Microprocessor Probes. One or more dedicated probes with disassembly for the 8080, 8085, 6800, 6802, 6809E, Z-80, 8086, and 68000 MPU's.

2. **Waveform Analyzer Option:**

For recording analog signals using high-speed (50 MHz) A/D conversion and software smoothing techniques. Includes one Model 90 (10X/1X) probe, if probe not otherwise provided with another option.

3. **Counter-Timer/Signature Analyzer Option:**

For performance monitoring and troubleshooting of the system-under-test. Includes one Model 90 (10X/1X) probe, if probe not otherwise provided with another option.

2.2 VERIFICATION OF ORDER

The original purchase order and the shipper should be checked against the equipment received. If an item which appears on the Purchase Order is missing and is not on the shipper as a back-ordered item, immediately notify Nicolet Paratronics or one of our local sales offices.

2.3 BASIC ANALYZER VERIFICATION TESTS

2.3.1 EQUIPMENT HANDLING

The NPC-800 utilizes a modular construction in a rugged mechanical package. However, the operating environment temperature should be kept between 10° and 45°C (50° - 133°F). Also, avoid use or storage of the equipment in dusty, smokey, or high static electricity areas. For the NPC-864MSTWC, as with other disk-based equipment, careful handling of disks and the disk drive is recommended.

2.3.2 PROGRAMMABLE AC VOLTAGE SELECTOR CARD

WARNING

BEFORE APPLYING POWER TO THE NPC-800, MAKE CERTAIN THAT THE PROGRAMMABLE AC VOLTAGE SELECTOR CARD, WHICH PLUGS INTO THE AC LINE CORD CONNECTOR/FUSE ASSEMBLY AT THE REAR OF THE NPC-800, IS INSERTED IN THE POSITION CORRESPONDING TO THE LINE VOLTAGE BEING USED; OTHERWISE, SERIOUS DAMAGE TO THE INTERNAL SWITCHING POWER SUPPLY MAY OCCUR.

The voltage selector card, shown in Figure 2-1, has three nominal voltage options: 100V, 115V, and 230V. The line voltage selected is visible without removing the card.

If it is necessary to change the line voltage, carefully grasp the card edge with a pair of long-nose pliers and reorient it so that the proper voltage appears with the card fully inserted.

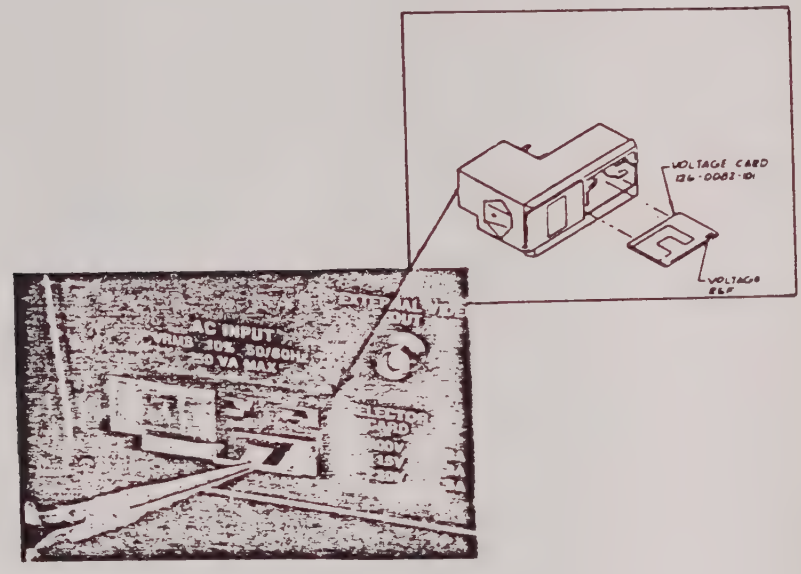

Figure 2-1. Programmable AC voltage selector.

2.3.3 BASIC STATE ANALYZER COLLECTION

1. Insert a Model 51A State Probe into the A (STATE) input on the left side of the NPC-800. Make sure the plastic key on the probe connector is facing up.

2. Plug the probe head into the A side of the Logic Analyzer Test Card. Make sure the probe switches are set to **TTL** and **TRUE**.

3. Turn power on using the power switch in the right rear side of the NPC-800.* If the unit is cold, wait up to 30 seconds for the CONFIGURATION LIST to appear. The half-intensity cursor should be located at the top of the list.

4. Press the F6 key, labeled **COLLECT** on the CRT, to take an arbitrary state data collection. The resulting display should contain twenty hexadecimal words whose four most significant digits contain values somewhere between 0000 and 00FF. The rest of the digits should be all F's. See Figure 2-2. See Section 6.2.1 for additional state data collection examples.

***NOTE:** The NPC-800 will emit a short beep upon power up or pressing **RESET**. This beep signifies that the NPC-800 has been reset.

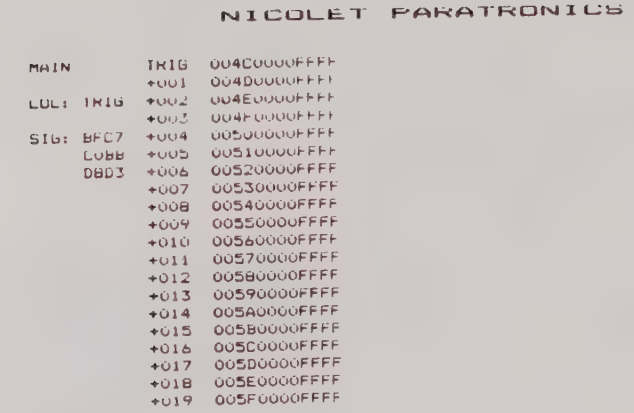

Figure 2-2. Arbitrary state data collection for NPC-864MSTWC.

2.3.4 BASIC TIMING DATA COLLECTION

1. Turn power off or press **RESET** for approximately 2 seconds to reinitialize the NPC-800.

2. Insert a Model 81A Timing Probe into the A (TIMING) input on the left side of the NPC-800. Make sure the plastic key on the probe is facing up. (You can leave the state probe connected to the analyzer.)

3. Plug the probe head into the B side of the Logic Analyzer Test Card. (There are no switch settings on this probe.)

4. Turn power on. After the CONFIGURATION LIST appears, move the cursor down to the 16-CHANNEL TIMING mode by pressing the F4 key labeled **SEL DOWN**.

5. Press **F6**, the soft-key labeled **COLLECT**, to take an arbitrary timing data collection. This collection should contain sixteen high or low logic levels as shown in Figure 2-3. Note also that the 100 nS sampling rate of the NPC-800 at power on is much faster than the clock rate of the CMOS test card. Therefore, few--if any--logic transitions will be captured. See Section 6.2.2 for additional timing collection examples.

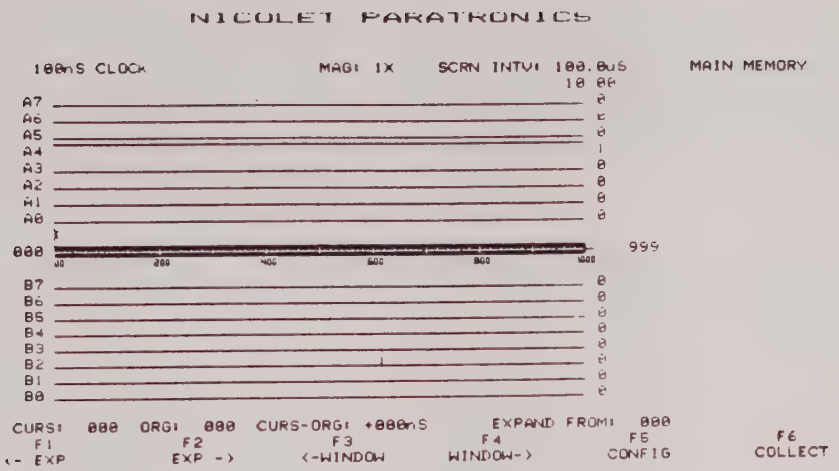

Figure 2-3. Arbitrary timing data collection. (Your data will probably differ.)

.3.5 BASIC WAVEFORM AND COUNTER-TIMER/SIGNATURE ANALYZER COLLECTIONS (Option Must Be Installed)

1. Press F5, the soft-key labeled **CONFIG.** The CONFIGURATION LIST should appear.

2. Using **F4**, the **SEL DOWN** key, step the cursor down to the WAVEFORM mode.

3. Press the **COLLECT** key. Since the Model 90 (10X/1X) scope probe is not connected and there is no input signal, the waveform display will contain only a baseline as shown in Figure 2-4. (If the Waveform Option is not installed, the display will not contain the baseline.) See Section 6.2.3 for additional waveform collection examples.

4. Repeat Steps 1 and 2 except step to the COUNTER/TIMER mode. Press the **F1** key. Since no input signal is present, the readout inside the display window should be all zeroes. (If this option is not installed, the display window will be blank.) See Section 6.2.4 for additional examples.

5. Repeat Step 4 except step down to the SIGNATURE ANALYZER MODE. Since no input or gating signals are present, there won't be any meaningful display. (This test verifies the presence of the menu only.) See Section 6.2.5 for additional examples.

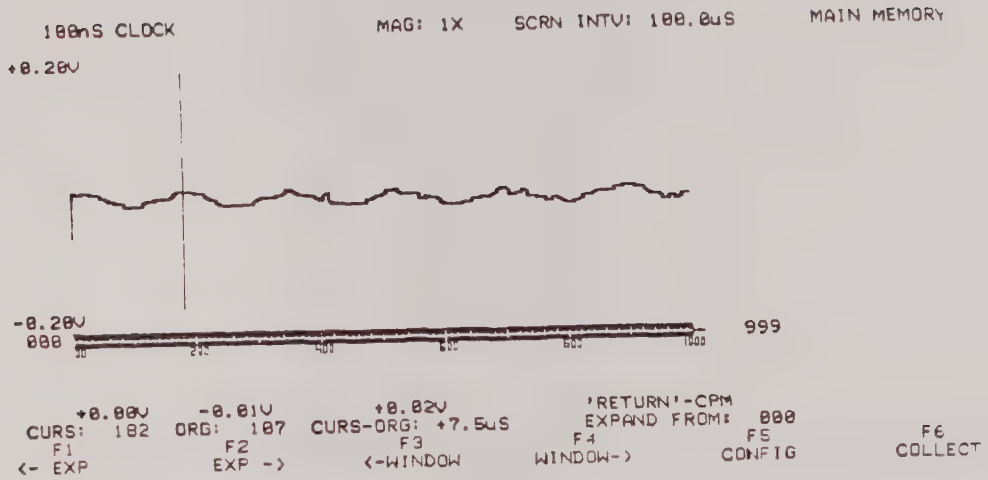

Figure 2-4. Waveform display without an input signal.

2.3.6 SCREEN ADJUSTMENT

If it is desired to adjust CRT screen brightness and contrast, use the following procedure:

1. Press the red **RESET** key for approximately two seconds as an alternate way to obtain the CONFIGURATION LIST. Then press the F1 key labeled **STATE** to display the state menu.

2. Adjust the **BRIGHTNESS** and **CONTRAST** controls at the left of the CRT to accommodate ambient lighting conditions. Make sure the adjustments provide adequate contrast between the half-intensity and full-intensity characters.

2.3.7 50 Hz/60 Hz CRT FRAME RATE SELECTION

If the CRT display appears shifted up or down, it is probably because the setting of the **CRT FRAME RATE** switch on the Processor Board does not correspond to the line frequency being used. Figure 2-5 shows the location and settings of the **CRT FRAME RATE SELECT** switch.

FRAME RATE SELECT SWITCH

The dip switch is accessed by first switching off the AC power and then removing the top cover by loosening the two quarter-turn fasteners on the rear of the cover. Note that the card cage hold-down strap may have to be removed to change the switch setting. Turn AC power on to check frame positioning and reverse the setting of S8, if necessary.

CRT Frame Rate Select	S8
50 Hz	OFF (Down)
60 Hz	ON (Up)

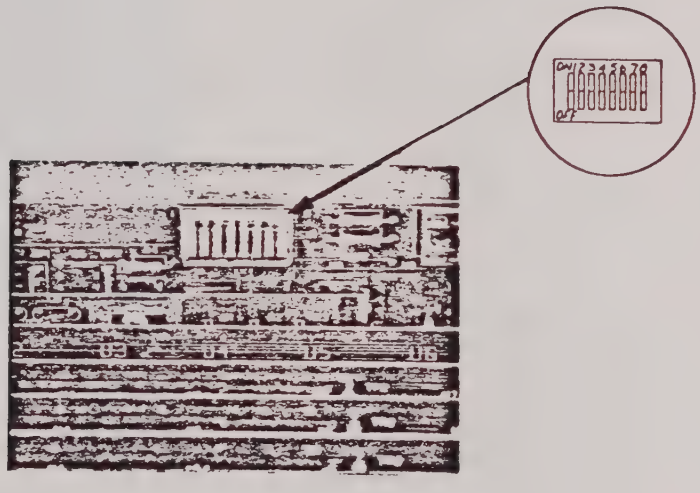

Figure 2-5. CRT FRAME RATE SELECT switch on Processor Board.

2.3.8 DISK SUBSYSTEM (NPC-864MSTWC)

The diskette should be kept inside its paper protective envelope when not in use. Note that the recording medium of the diskette is contained within a sealed plastic jacket. **DO NOT ATTEMPT TO REMOVE THE PLASTIC JACKET.**

To insert the diskette into the disk drive, first remove the diskette from the paper envelope. Notice the large, circular opening in the center of the diskette, the long oval READ/WRITE head opening, and a square WRITE PROTECT notch along one edge of the diskette.

DISKETTE INSERTION

To insert the diskette, orient the plastic jacket so that the WRITE PROTECT notch is at the bottom and the label faces towards the CRT. See Figure 2-6.

Carefully slide the diskette into the vertical opening on the drive until no additional movement in the direction of insertion is possible. Now mount the diskette to the drive by pulling the drive door handle to the right until the handle latches, firmly clamping the diskette onto the drive motor spindle. An interlocking mechanism prevents the door from closing if the diskette is not properly loaded.

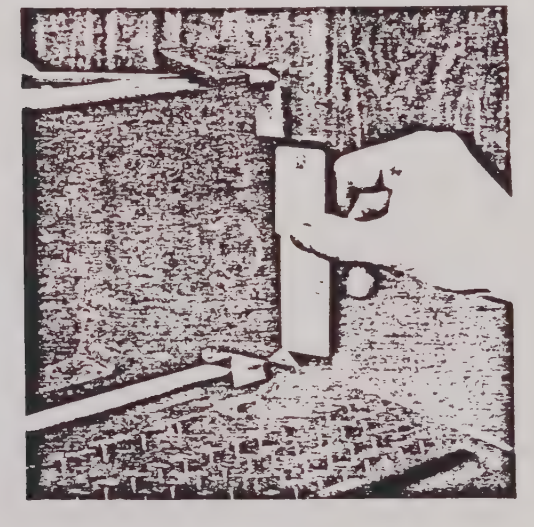

Figure 2-6. Diskette orientation for loading.

DISKETTE REMOVAL

Removal of the diskette requires a releasing of the latching mechanism. A partially ejected position is acceptable during power-up/down of the NPC-864MSTWC.

WARNING

To protect the data on the diskette, it is good practice **NEVER** to interrupt power to the NPC-864MSTWC when a diskette is fully mounted on the drive.

2.3.8.1 WRITE PROTECT FEATURE AND ORIENTATION

The WRITE PROTECT notch, when covered, protects the contents of the diskette from accidental alteration. A microswitch detects the presence or absence of a notch in the side of the diskette. When the open notch is sensed, writing is allowed. When the notch is not sensed (covered with a tab), writing is inhibited and a status signal informs the disk controller that a WRITE PROTECT condition exists.

2.3.8.2 CONTAMINATION AND STORAGE OF DISKETTES

In order to protect the integrity of your data, menus, and programs, your diskettes should be handled with care. The following recommendations should be observed:

1. Always dismount the diskette from the drive before power-up/down of the NPC-864MSTWC to avoid possible loss of information on the diskette.
2. Return the diskette to its storage envelope whenever it is removed from the disk drive.
3. Keep diskettes away from magnetic fields since exposure to such fields can affect the data.
4. Do not write on the plastic jacket with a lead pencil or ball-point pen. Use a felt-tip pen or a stick-on label.
5. Smoke, heat and ashes from cigarettes can damage a disk.
6. Do not expose diskettes to heat or sunlight.
7. Never remove a diskette from its plastic jacket.
8. Do not touch or attempt to clean the diskette surface since abrasions may cause loss of magnetized oxide and data.
9. Replace the paper storage envelopes when they become worn, cracked, or distorted.

2.3.8.3 ADJUSTMENTS

The disk drive motor is part of a servo-controlled loop and is independent of changes in line voltage and line frequency; therefore, no speed adjustment is necessary.

2.3.8.4 OPERATIONAL CHECK OF THE DISK SUBSYSTEM

1. If power was off, turn power on and load a CP/M diskette as described in Section 2.3.8; otherwise, call the CONFIGURATION LIST.
2. When the CONFIGURATION LIST is displayed, press the **ESC** (escape) key to exit the analysis mode and enter the CP/M mode. (The red LED on the disk drive will illuminate.)
3. Wait until a header and the CP/M prompt: A> appears. Next type **DIR** (directory) and **RETURN** to see the programs resident on the disk. A typical directory is shown in Figure 2-7. See Sections 9.0, 10.0, and 11.0 for additional CP/M information and examples.

2.3.8.5 DISKETTE

The NPC-864MSTWC uses a 5¼ inch, two-headed, double-density flexible disk drive. When buying additional diskettes, specify that the diskettes be certified for double-density, two side operation. Nicolet Paratronics' P/N 112-0503-0002 is Dysan's model 204/2D, PN802067 Soft-Sector, Double-Side, Double-Density, 96/100 tracks or an equivalent.

A few words of caution regarding diskettes: ALWAYS make a back-up copy. ALWAYS buy good quality diskettes. Many people have learned the hard way that these 2 rules are well worth the expense. Losing the only copy of a diskette, or losing a file due to accidental erasure, contamination, or poor quality media can be an expensive situation to correct.

```
  DIR
A: PIP      COM : XSUB     COM : ED       COM : ASM      COM
A: DDT      COM : LOAD     COM : STAT     COM : DUMP     COM
A: SUBMIT   COM : PRINT    COM : KYBDTEST COM : FORMAT2  COM
A: CRUN23   COM : FORMAT1  COM : GPIBEX80 COM : LARECALL COM
A: UC2      COM : LASAVE   COM : LADISA   COM : CM2      COM
A: LA       COM : RAMTEST  COM : SAVREC   COM : CRUN2    COM
A: CBAS     COM : XREF     COM : GPIBPS80 MAC : SAVREC80 MAC
A: GPIBPS80 REL : GPIBEX80 REL : SAVREC80 REL : SAVREC   ASM
A: GPIBEX   INT : GPIBEX80 BAS : LADISC80 BAS : GPIBEX   BAS
A: GPIB80   BAS : GPIB     BAS : LADISC   BAS : RS232EX  BAS
A: RS232EX  001 : RS232EX  002 : D6800          : D68000
A: D8085        : RS232EX  INT : DZ80           : D6809E
A: D488         : D8080        : D8086          : READ     ME
A: UC2      LST
A>
```

Figure 2-7. Typical CP/M diskette directory. (Your listing may differ.)

2.3.9 SELF-TEST

If you have difficulty operating the NPC-864MSTWC in the analysis or CP/M modes, built-in self-tests can help isolate the problem. Although these tests are not exhaustive, they can provide the NPC-864MSTWC operator with a high degree of confidence that various subsystems are operating properly. See Appendix B for a description of these self-tests. (The NPC-848S, NPC-816T, and NPC-864ST can only perform the Processor Self-Test since the other tests are on diskette.)

2.3.10 NOTES CONCERNING AIR FILTER MAINTENANCE

In order to assure proper internal cooling of your NPC-800, you should clean the air filter periodically. The frequency of the cleaning will depend on the operating environment; however the filter should be cleaned at least once every six months.

The filter is located on the upper-rear-corner of the analyzer and is held in place by three brackets attached with phillips drive screws. To remove the filter, loosen and remove the knurled thumbnut which holds the bottom bracket in place. Remove the bracket from the threaded stud. Slide the filter down and out to remove it.

Clean the filter with soap and water, a mild solvent or with air. Dry the filter and depress the inner surface gently so that the filter material bulges outward, away from the seam in the filter frame. Replace the filter in the two upper brackets, making certain that the seam in the frame is facing the back panel, and the bulge in the filter material is facing outward. Replace the lower bracket and tighten the thumbnut "finger-tight."

CAUTION: Failure to keep the filter clean could result in excessive heat generation and equipment malfunction which may void the warranty.

2.4 RETURN OF EQUIPMENT

If the unit must be sent back to the factory or an authorized service center for any reason, contact Nicolet Paratronics or your local sales office for instructions and a RETURN AUTHORIZATION NUMBER.

NOTE: EQUIPMENT RETURNED TO THE FACTORY OR SERVICE CENTER **WITHOUT PRIOR AUTHORIZATION** CANNOT BE ACCEPTED. (BY CONTACTING US FIRST, WE MIGHT BE ABLE TO SOLVE YOUR PROBLEM AND SAVE YOU A LOT OF TROUBLE.)

2.4.1 SUGGESTIONS CONCERNING RETURN OF EQUIPMENT

If you have authorization to return equipment, use the original shipping container and packing material, if possible. Also, it is always a good idea to insure any equipment shipped.

If the subassembly, board, PROM, diskette, or other component responsible for the problem can be identified (with or without the help of our application engineers), it is often more convenient, and certainly less costly, to return just the faulty item rather than the entire instrument.

IMPORTANT NOTE

U.S. CUSTOMERS SHOULD CONTACT OUR CUSTOMER SERVICE DEPARTMENT FOR ASSISTANCE AT:

(800) NICOLET (Toll-Free outside California
(415) 490-8300 (California)

OUR CUSTOMER SERVICE ENGINEERS CAN ANSWER QUESTIONS AND AUTHORIZE RETURN OF EQUIPMENT.

INTERNATIONAL CUSTOMERS SHOULD DEAL DIRECTLY WITH THEIR LOCAL NICOLET PARATRONICS SALES AND SERVICE CENTER.

Regardless of how you proceed, please send a description of the problem along with the faulty item. If you return the entire instrument, be sure and **INCLUDE ALL PROBES.**

3.0 KEYBOARD

3.1 KEYBOARD ARRANGEMENT

Figure 3-1 shows the keyboard of the NPC-800. This keyboard allows the operator to send data to the computer and to make data entries or menu changes in the logic analyzer and other analysis sections of the instrument. Most of the keys are the same as they are on an ordinary terminal or typewriter; i.e., they type the same alphanumeric characters. This familiar arrangement permits faster programming and menu set-ups without learning dedicated keys.

You cannot damage the computer or the logic analyzer by typing on the keys.

The keyboard assembly folds up conveniently over the CRT and disk drives for their mutual protection during transport.

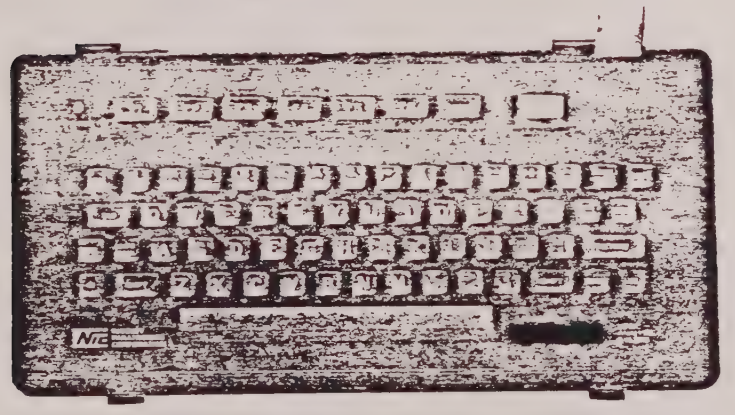

Figure 3-1. The NPC-800's detachable, folding keyboard. (NPC-864MSTWC shown.)

Whenever you turn on the NPC-800, allow 5-30 seconds for the CRT to warm up. The NPC-800 is in the Analyzer Mode upon power up and the initial display is a list of analysis functions. For the NPC-864MSTWC, in order to use the keyboard for computer operations, you must escape the Analyzer Mode by pressing the ESC key. Then you can load a CP/M diskette as described in Section 2.3.8.4. After the CP/M version number appears, you should then see a line and a blinking reverse video block cursor in the upper left-hand corner (the home position) of the screen.

The cursor identifies where the next character can be written. The screen contains 2000 normal character positions or 25 lines of 80 characters each. Only one character can occupy a character position at any given time and it will remain there until it is erased or replaced. Upon pressing the ESC key, the processor clears the screen by placing spaces in all character positions.

The keyboard consists of single-pole/single-throw switches in a matrix that is scanned by keyboard-encoding hardware located in the keyboard. The hardware is periodically polled by the software.

3.1.1 ALPHABETIC KEYS

The keyboard incorporates the standard 26 letters of the alphabet in lower-case or upper-case as determined by the **SHIFT** key. Use the **CAPS LOCK** key to obtain upper-case letters only.

3.1.2 NONALPHABETIC KEYS

The nonalphabetic keys are those with double markings. These include the numbers 0 through 9, punctuation marks, and special characters. The lower marking is generated when the **SHIFT** key is released, while the upper marking is generated with the **SHIFT** key down. The **CAPS LOCK** key will not shift these keys.

3.2 NONDISPLAYABLE KEYS

In addition to the standard typewriter keys, the following eleven function keys are included in the keyboard:

RETURN -- Moves the cursor to the first character position. If the cursor is already at the first character position, it remains there. **RETURN** is also called "carriage return" (CR). An automatic line feed is included in the **RETURN** function.

LINE FEED -- Moves the cursor down one line. If the cursor is at the bottom line, a **LINE FEED** causes it to remain there, but all of the data on the screen moves up one line. Data on the top line are lost as they are scrolled up and off the screen.

SPACE BAR -- Causes the cursor to move one character position to the right. If you depress the **SPACE BAR** when the cursor is at the right end of a line, the cursor will remain there since neither a carriage return nor a line feed is generated.

BACK SPACE -- Moves the cursor one space to the left. If the cursor is at the start (left end) of a line, it will not move when you depress the **BACK SPACE** key.

DELETE -- Causes the last character entered to be cancelled.

TAB -- Moves the cursor to the next tab stop (eight character spaces) to the right. Using columns numbered from 1 through 80, the tab stops are fixed at 9, 17, 25, 33, 41, 49, 57, 65, and 73. If the cursor is at a character position 73 through 79, it will only move one character position to the right each time you depress the **TAB** key. If the cursor is at character position 80, it will not move.

ESC (Escape) -- In a general sense, causes the software to enter and exit special modes. For the NPC-864MSTWC, **ESC** accesses the CP/M mode. **ESC** can be used with other keys in the CP/M mode.

REPEAT -- When you hold this key down, along with another key, it will repeat the function of the other key as long as both keys are held down. The repeat rate is approximately 5-characters per second.

BREAK -- When you select this key, it generates a continuous space and is generally used to tell the computer that you wish to interrupt program execution. With the Configuration List displayed, the **break** key initiates PROCESSOR SELF-TEST. See Appendix B.

S1, S2 -- These two keys are additional special keys that function according to prompts in the logic analyzer menus.

CTRL -- This key is held down while you push one of the other keys to send control codes to the processor. See Section 7.1.1 for ASCII control code definition.

3.3 SPECIAL KEYS (F1-F6, LABELS, RESET)

3.3.1 F1-F6

There are six software-directed ("soft") keys below the CRT that are automatically labeled on the screen by software.

3.3.2 LABELS

Depressing the **LABELS** key causes a prompting message to appear on the right-hand side of the CRT.

The prompting message is dependent on the analysis mode in use and lists the keys that can be selected to alter menus, change display formats, and save or recall data.

3.3.3 RESET

The red **RESET** key returns the NPC-800 to the initial power-on condition: processor RAM is cleared and the CONFIGURATION LIST appears on the CRT. A beep indicates completion of **RESET.**

NOTE: **RESET** will erase all menu parameters and auxiliary memory data.

In order to avoid causing an accidental **RESET**, the key must be held down for approximately two seconds.

3.4 SPECIAL COMMANDS

3.4.1 LASAVE (NPC-864MSTWC) (LOGIC ANALYZER DATA SAVE)

This command is used to save on disk, all of the analyzer data in the NPC-864MSTWC's state and timing/waveform **auxiliary memories** and the associated menu parameters. To use this command after making a data collection, return to the CONFIGURATION LIST with the **CONFIG** key and press the **ESC** key. The NPC-864MSTWC will exit to the CP/M operating system. Then type:

LASAVE FILENAME **(RETURN)**

A file will be created on the disk called FILENAME and will contain analyzer set-up information and associated data. (You can use any name for your file, 8 letters or less.) When file creation is complete, the NPC-864MSTWC will return to the analyzer configuration.

The following information is contained in a 12 Kbyte file saved on the diskette:

- o Main State Menu
- o Auxiliary State Menu
- o Auxiliary State Data
- o State Display Parameters
- o Main Timing Menu
- o Auxiliary Timing Menu
- o Auxiliary Timing/Waveform Data
- o Timing/Waveform Display Parameters
- o Main Waveform Menu
- o Counter-Timer Menu
- o Signature Analyzer Menu
- o Serial Transmit Menu
- o I/O Menu
- o Auxiliary Waveform Menu

NOTE: Main state data and main timing/waveform data are not automatically saved. Thus, if you want to save main memory data, it's necessary to first transfer it to the corresponding auxiliary memory by pressing the **S (SAVE)** key, prior to entering the CP/M operating system and executing the LASAVE command.

3.4.2 LARECALL (LOGIC ANALYZER (NPC-864MSTWC) DATA RECALL)

This command is used to recall analyzer set-up and data from a file created previously with LASAVE. To use this command, return to the CONFIGURATION LIST and press **ESC**. Then type:

LARECALL FILENAME **(RETURN)**

The information in the selected file will be recalled back into the analyzer's auxiliary memory. At this point, the NPC-864MSTWC will be configured exactly the same as it was when the file was originally created, including all the menu parameters and the associated data, except for the main state data and the main timing/waveform data.

NOTE: See Section 6.3.1 for examples of disk storage and recall functions. See Section 11.12 for an example of how to use the CP/M SUBMIT utility together with LASAVE and LARECALL to automate tests.

Also, see Section 10.4 for a description of how to implement LASAVE and LARECALL from a CBASIC program.

3.4.3 AUTO COLLECT

Press CTRL and **C** simultaneously to activate an automatically repeating data collection mode. Press any ASCII key to stop.

5.0 MENUS AND DISPLAYS

The power and ease-of-use of the NPC-800 Logic Analysis System results from the straight-forward interaction of each menu with the keyboard. In fact, much of this section of the Operator's Manual is contained in the software which directs the user to the proper keystroke sequence. **In general, keyboard entry of commands or data follows these basic guidelines:**

1. The information displayed is always the current state of the analyzer.

2. Parameters that can be modified by the user are identified on the video display screen by an inverse video field.

3. Keyboard entries are placed into the menu at the position identified by a blinking cursor.

4. To move the cursor from one field to the next, use the PREVIOUS and NEXT keys.

5. To move the cursor within a field, use the SPACE BAR and BACK SPACE keys.

6. When some menus are displayed, F3 and F4 are labeled at the bottom of the CRT as SELECT and DEFAULT, respectively. Pressing SELECT causes each of the available options for that field to be selected. This simplifies the specification of some parameters and allows the user to scroll through all options to select the one most appropriate. Depending on the field, DEFAULT returns the field to the power-on condition or moves the cursor to the beginning of the field.

7. For immediate movement of the cursor to a nonadjacent field of interest in the menu, the DIRECT keys, C (CLK QUALIFIER), P (PRETRIG), and T (TRIG), can be used. In the menu mode, pressing the S2 key followed by the LABELS key places a series of labels on the right side of the video display which define the function of each DIRECT key. Pressing one of the DIRECT keys calls the menu and steps the cursor directly to the corresponding field in the menu.

8. If an attempt is made to set up an illegal condition, an error message (in English) flashes on the CRT indicating which keys are appropriate for the current field.

HELP (?)

9. In most data entry fields, pressing the ? key displays a prompting message on the screen indicating the type of data or commands that can be entered into the current field.

5.1 INITIALIZATION

When the NPC-800 is first switched on, a processor test series can be performed that checks the RAM, ROM, and other subsystems.* As indicated at the bottom of the CONFIGURATION LIST, pressing the BREAK key activates PROCESSOR SELF-TEST.

---

*It is possible to manually expand this self-test. (See Appendix B.)

5.1.1 CONFIGURATION OPTIONS

To call the CONFIGURATION LIST, after executing PROCESSOR SELF-TEST, press **RESET** for 2 seconds or cycle power. After several seconds, the CONFIGURATION LIST is displayed and the cursor appears at the top of the list. Ten configurations are possible if the optional Counter-Timer/Signature Analyzer (CTSA) and Waveform boards are installed.

5.1.2 CONFIGURATION LIST DISPLAY

The parameters for each of the menus associated with the CONFIGURATION LIST are described in the remainder of this section. The user is encouraged to experiment with all test parameters, triggering modes, and display formats in order to gain more familiarity with the range and power of the instrument. See Section 6.0 for basic and advanced examples using the Logic Analyzer Test Card supplied with the NPC-800. See Sections 14.3 and 14.4 for I/O (RS-232 and IEEE-488) examples.

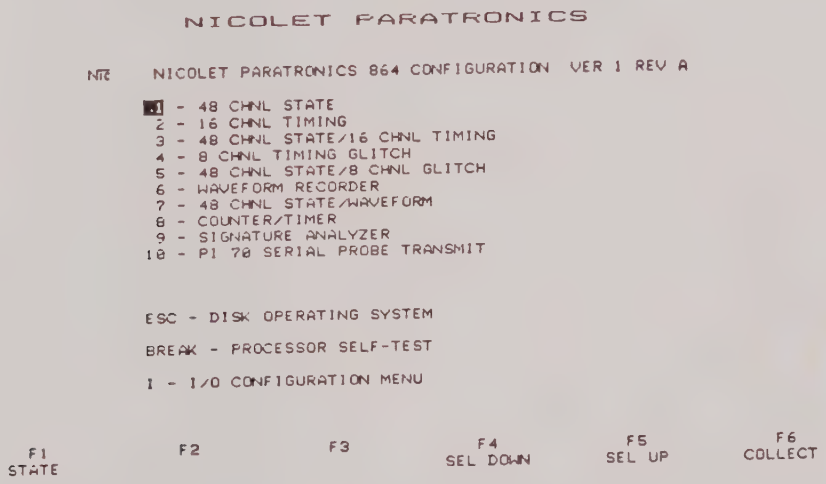
NICOLET PARATRONICS
NIC NICOLET PARATRONICS 864 CONFIGURATION VER 1 REV A
1 - 48 CHNL STATE
2 - 16 CHNL TIMING
3 - 48 CHNL STATE/16 CHNL TIMING
4 - 8 CHNL TIMING GLITCH
5 - 48 CHNL STATE/8 CHNL GLITCH
6 - WAVEFORM RECORDER
7 - 48 CHNL STATE/WAVEFORM
8 - COUNTER/TIMER
9 - SIGNATURE ANALYZER
10 - P1 70 SERIAL PROBE TRANSMIT
ESC - DISK OPERATING SYSTEM
BREAK - PROCESSOR SELF-TEST
I - I/O CONFIGURATION MENU
F1 STATE
F2
F3
F4 SEL DOWN
F5 SEL UP
F6 COLLECT

Figure 5-1. Configuration List. (NPC-800MSTWC shown.)

In the above display, each line represents one possible configuration of the analyzer. Position the half-intensity cursor on the number of the configuration desired, using **SEL DOWN (F4)** or **SEL UP (F5)**. Then press **F1** to display the menu that will be used to establish the data collection parameters.

ESC/RESET

For the NPC-864MSTWC, you can exit from the Analyzer Operating System and enter the CP/M Operating System by pressing **ESC**, the "escape key." The disk drive will turn on and load CP/M. A prompt 'A ' will appear. To return to the logic analyzer operating system, type **LA CR**. Alternatively pressing the RESET key for 2 seconds will cause the analyzer to return to the analyzer operating system.

I/O

For the NPC-800, you can call the I/O configuration menu by pressing the I key. To return to the CONFIGURATION LIST, press the **CONFIG (F5)** key.

5.2 48-CHANNEL STATE MENU

A. TO CALL MENU:

1. Press the **CONFIG** or **RESET** key.
2. Using the **SEL DOWN (F4)** or **SEL UP (F5)** key, move the cursor to the 48 CHANNEL STATE mode (if necessary).
3. Press the **STATE (F1)** key.

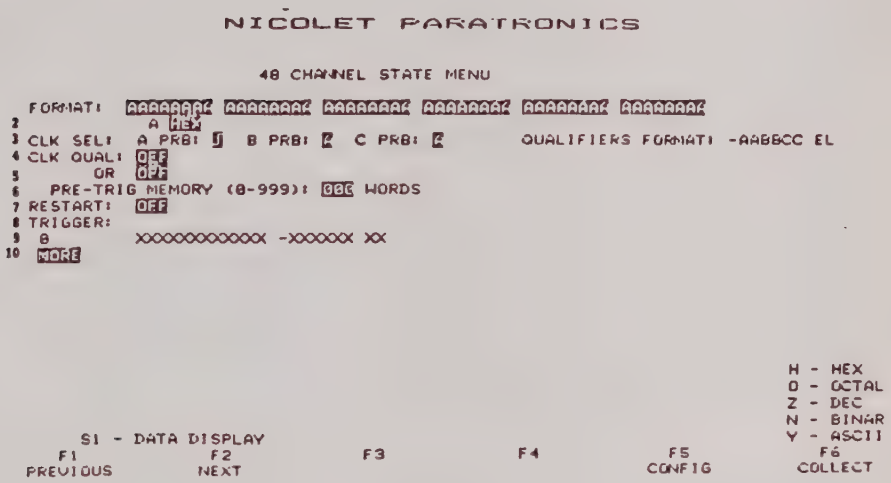

Figure 5-2. The NPC-800's 48-Channel State Menu. (Flashing prompting messages are not shown.)

B. EXPLANATION OF MENU:

FORMAT

Line 1: Using the labels A-F, this field allows the definition of a mixed-format state display consisting of any combination of HEX, OCT, BIN, DEC, and ASCII characters. The MSB of the A probe is at the far left of the field, the MSB of the B probe is the 17th bit from the left, the MSB of the C probe is the 33rd bit from the left. (Note that the labels A-F are completely general and have no relationship to the names "A probe," "B probe," and "C probe.")

When the menu is first called, the format field contains all A's. Use the A-F or X keys to insert other labels to establish the required groupings of the individual input data bits. Note that the label keys must be entered in order, i.e., AAAAAAAA BCCCCCCC ..... An X placed in any bit position will blank or mask that bit in the state display.

LABELS A-F

Line 2: Press NEXT (F2) and use the HEX, OCT, DEC, BIN, or ASC keys (H, O, Z, N, or Y) respectively, to define these labels. (The default value is hex for all labels.)

CLOCK SELECT

Line 3: Selects the polarity of the A, B, and C clocks coming into the A, B, and C probes, respectively. If multiphase clocking is not required, the B and C probe clocks should be set to A (i.e., same as A probe clock); otherwise, use the appropriate clock edge, (F3) for positive, (F4) for negative.

QUALIFIERS: -AABBCC EL.

This is an identifying label only. The first A bit signifies the A probe's qualifier #1 (Q1 on the probe label); while the A probe's second A bit signifies the second qualifier #2 (Q2 on the probe label). The two B's and C's signify the same information for the B probe and C probe, respectively. Use of the E bit adds an EXTERNAL INPUT as a further qualifying condition while use of the L bit can LINK the internal State and Timing Analyzers or another, external NPC logic analyzer.

CLOCK QUALIFIER #1

Line 4: This is the first of two OR'ed clock qualification conditions that can be imposed on the data collection of the State Analyzer. This field normally defaults to OFF. With the OFF cursor flashing, pressing the SELECT (F3) key activates this field. The qualifier field consists of a 48-bit word (for data qualified clocking), followed by the six A, B, and C probe qualifier inputs (AABBCC), plus the E bit described above. This 55-bit word will automatically be grouped in accordance with the predefined display format. To set up the qualifier field, simply enter in the HEX, OCT, DEC, BIN, or ASCII digits as required. If a digit entered is out-of-range for the format used, the software will automatically "drop off" higher-order bits down to the number of bits allowed in the field. Also, values must be within the range of the selected base--such as 0-7 for an octal digit; otherwise an error message will appear.

Single formats can be used in this field independently of the format used for the RESTART word, TRIGGER word, or display. Simply press the HEX, OCT, etc., key for the single format of your choice. To recover the original display format used in Line 1, press the USER key, U. Note that to enter an ASCII character, the 2-digit HEX equivalent must be used. See Section 7.1.1 for a HEX-ASCII conversion table. The six probe qualifier bits can be entered only as 0, 1, or X; the E bit can only take on a 1 or X value.

CLOCK QUALIFIER #2

Line 5: This is the second OR'ed clock qualifier. It is set up in exactly the same way as the first qualifier. See Section 7.2 for additional information.

PRETRIG

Line 6: The PRETRIG field specifies the number of words that the analyzer will collect prior to the trigger word.

RESTART*

Line 7: The RESTART field defaults to OFF. Pressing the SELECT key establishes a 48-bit word group in accordance with the specified display format, plus an 8-bit qualifier group. If this RESTART word is encountered, it will cause the trigger stack (described below) to return to level 0. See Section 8.1.3 for additional information.

Pressing the SELECT key again causes a bar (NOT indicator) to appear across the top of the RESTART word. This RESTART condition means that the analyzer will return to the top of the trigger stack (level 0) when anything other than the RESTART word is encountered.

TRIGGER STACK

Lines 8 to 12: These lines are used to set up 16 sequential triggering levels. Since only 4 levels can appear on the screen at one time, a scrolling technique is used to set up and display the remaining levels. The data keys are used to enter the 48-bit triggering conditions plus the 8 trigger qualifier conditions specified in the label: -AABBCC EL. (NOTE: If it is desired to set up a nonoccurrence triggering condition at any level, press the SELECT key, F3, to place a bar across the top of the TRIGGER word.)

DELAY

After level 0 is set up, the MORE field will flash. Pressing the SELECT key will access level 1 and display the associated delay mode. After level 1 data entry is complete, if the field has been filled ... the cursor will move to the DELAY field. If the field is not full, press F2 (Next) key to move into the DELAY field. Use the SELECT key to choose the desired delay mode from the following choices:

AFTER nnnn CLOCKS
NOT ON nnnn CLOCKS
BEFORE nnnn CLOCKS
ON nnnn CLOCKS
OCCURS nnnn TIMES

Use the numeric keys to complete the DELAY field.

When level 3 is complete and level 4 is called, level 0 scrolls off the top of the stack display and is no longer displayed. This process can be continued until level 15 is completed. To roll the stack back and forth, use the PREV and NEXT keys, F1 and F2.

LABELS

Lines 16 to 21: These fields are labels that indicate which key selects the format in which the data will be displayed. For example, press H to display all data in HEX. Press U to display data in the format specified in the menu.

---

* A RESTART word of all X's is not the same as OFF, and will cause the analyzer to continually reset the trigger stack to zero and never collect data (unless the TRIGGER words are also all X's).

S1	Line 21: Press the S1 key to return to the data display without making a new data collection.
F1 - F6 (FUNCTION KEYS)	Line 22: Soft-key identifiers.
PREVIOUS (F1)	Line 23: Moves the cursor back to the previous field.
NEXT (F2)	Moves the cursor ahead to the next field.
SELECT (F3)	Used to display the options of the current field. Each time the **SELECT** key is pressed, a new option is displayed until the original option comes up again. If the cursor is moved with the **PREV, NEXT** or direct entry keys, the option displayed last becomes the operative parameter.
DEFAULT (F4)	Depending on the field, **DEFAULT** returns the field contents to the same value as that displayed upon initialization or moves the cursor to the first character position.
CONFIG (F5)	Returns to the CONFIGURATION LIST.
COLLECT (F6)	Initiates a new data collection.
BACK SPACE	Moves the cursor back one character position within the current field. (Field contents are unchanged.)
SPACE BAR	Moves the cursor ahead one character position within the current field. (Field contents are unchanged.)

5.2.1 48-CHANNEL STATE DATA DISPLAY

A. TO CALL DISPLAY:

1. Press the **COLLECT** key, **F6**, to perform the data collection. (One or more probes must be connected to the Logic Analyzer Test Card or a circuit-under-test; otherwise a WARNING-SLOW CLOCK message will appear and no data will be collected.)

2. If data has already been collected, press **S1** to call the display.

NICOLET PARATRONICS

MAIN		TRIG	006F0000FFFF
		+001	00700000FFFF
LOC:	TRIG	+002	00710000FFFF
		+003	00720000FFFF
SIG:	BF7F	+004	00730000FFFF
	C0B8	+005	00740000FFFF
	D8D3	+006	00750000FFFF
		+007	00760000FFFF
		+008	00770000FFFF
		+009	00780000FFFF
		+010	00790000FFFF
		+011	007A0000FFFF
		+012	007B0000FFFF
		+013	007C0000FFFF
		+014	007D0000FFFF
		+015	007E0000FFFF
		+016	007F0000FFFF
		+017	00800000FFFF
		+018	00810000FFFF

Figure 5-3. The NPC-800's 48-Channel State Data Display.

B. EXPLANATION OF 48-CHANNEL STATE DISPLAY:

MAIN (AUX)

Line 1: MAIN (AUX) memory identifier. Also, location of trigger word when the trigger word is at the top of the CRT.

TRIGGER/WORD LOCATOR

Line 3: Trigger and word locator field. Field accepts 3-digit word number plus sign. See LOCATE below.

TEST CODES

Lines 5 to 7: Test codes (SIG) of data collection. See Section 7.12.

DATA

Lines 1 to 20: Word number and associated data for 20 of the 1000 words collected. Note that the display is formatted in accordance with the FORMAT field previously set up.

LABELS

Lines 3 to 23: Menu for manipulating displayed data appears on right side of the CRT by pressing the LABELS key. Pressing the S1 key clears the menu.

DIRECT KEYS
C-CLOCK QUAL
P-PRETRG
T-TRIG

C, P, or T will cause the state menu to be displayed, with the cursor in the field: CLOCK QUALIFIER, PRETRIGGER, or TRIGGER, respectively.

M-MEMSEL

M will select the AUX or MAIN memories for display.

S-SAVE*

S will write MAIN memory data into AUX memory.

R-RECALL*

R will return previous menu data into AUX memory.

---

*NOTE: These commands provide temporary data storage/recall functions using the internal AUX RAM. The disk is not required for these functions.

DISPLAY FORMAT

H, O, Z, N, Y, or U will display all data in the single format selected.

NOTE: The HEX, OCT, DEC, BIN, ASC, and USER formats serve two basic functions: When used within a menu, the bits in each data entry field are grouped into digits corresponding to the selected format; when used with data, they control the format displayed.

H - HEX

Causes state data or a data entry field to be displayed in a hexadecimal format.

O - OCT

Causes state data or a data entry field to be displayed in an octal format.

Z - DEC	Causes state data or a data entry field to be displayed in a decimal format.
N - BIN	Causes state data or a data entry field to be displayed in a binary format.
Y - ASC	Causes state data to be displayed in 7-bit ASCII format. (Leading bits are ignored.)
U - USER	Causes the mixed format defined in the menu by the user to replace the current display.
1 - MNEMONICS (NOT SHOWN)	Displays collected data in assembly language using disassembler program selected from diskette. (See Section 6.5.)
# - HOLD≠	Pressing the # key calls the HOLD≠ mode. This mode is similar to COLLECT: It causes a data collection to be made according to the parameters specified in the menu. However, in the HOLD≠ mode, the data from the current data collection (main memory) is compared with the reference data in the auxiliary memory (previously stored using the SAVE key). If a difference is detected, the NPC-800 will stop the data collection process and display the data. The differences in the data can be highlighted on the screen by using the DIFFERENCE function described below. If the data in the main memory are the same as the reference data, the collection process is automatically repeated until a difference is found. The message SAMPLING is displayed while collecting data and the message HOLDING is displayed when a difference between MAIN and AUX memories has been detected.
/ - DIFFERENCE	Pressing the / (DIFFERENCE) key once causes the information in the main memory to be compared to the reference data in the auxiliary memory. Data words that are identical are displayed at half-intensity; words exhibiting differences are displayed at full intensity. Pressing LOCATE and D finds the first difference. Alternating between AUX and MAIN memories (M + REPEAT) further highlights differences in data. The word DIFFERENCE on the screen indicates that the DIFFERENCE mode has been activated. Pressing the / key again deactivates the DIFFERENCE MODE.
K - SEARCH UP, J - SEARCH DOWN	K, SEARCH UP, and J, SEARCH DOWN are used in conjunction with SEARCH WORD mode described below.
COLLECTION STATUS	Line 21: If triggering conditions are met, the message TRIGGERED is briefly displayed, followed by the message DONE when the 1K state data memory is full. If the sequential trigger stack is used and triggering conditions are not met at a particular trigger level, that level is identified and data are not displayed. If there is not enough incoming data to fill the 1K state memory, the amount of data words

actually collected is also displayed. If no input clock is being detected or if the clock period is greater than approximately 1 second, the message WARNING-SLOW CLOCK 0000 will be displayed.

F1 - F6 (FUNCTION KEYS)

Line 24: Soft-Key identifiers.

SCROLL (F1, F2)

Line 25: The **SCRL DWN** and **SCRL UP** keys allow the viewing of different portions of the data collection. Note that **BACKSPACE** and **SPACEBAR** keys can also be used for scrolling the down and up, respectively.

LOCATE (F3)

The **LOCATE** key is used to position the cursor at the LOC field in the state display. After pressing the **LOCATE** key, the user enters a + or - followed by a three-digit number that represents the word location in memory relative to the trigger word. Pressing **LOCATE** and **T** places the trigger word at the top of the screen; pressing **LOCATE** and **B** places the beginning of the state collection (not necessarily the trigger word) at the top of the screen; pressing **LOCATE** and **E** places the end of the collection at the bottom. Pressing **LOCATE** and **D** when using the difference mode places the first full-intensity difference line at the top of the screen. Repeating **LOCATE** and **D** will move the next difference word to the top of the display. Pressing **LOCATE** and **S** places the first half-intensity same word at the top of the screen.

SEARCH WORD (F4)

Pressing the **SRCH WRD** key, **F4**, provides a rapid method of locating a particular word or bit pattern within a data collection. Pressing the **SRCH WRD** key activates the following menu:

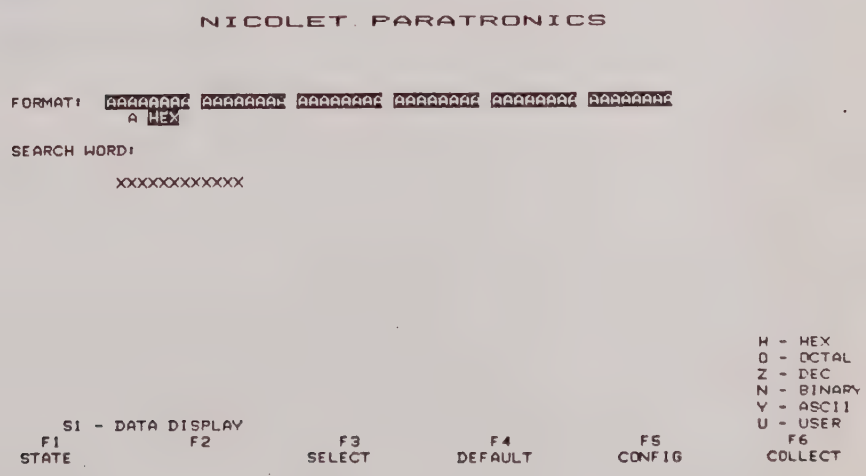

Figure 5-4. Search Word Menu.

Pressing **PREVIOUS** or **NEXT** causes the display to return to the STATE menu to allow changes in the FORMAT field.

Once the desired word is entered in the SEARCH WORD field, return to the data display mode and then press the K (SEARCH UP) or J (SEARCH DOWN) key to initiate a search for that word in the data memory. When the SEARCH WORD is located, it is positioned at the top of the screen. Additional occurrences of the SEARCH WORD are found by again pressing the K or J key.

CONFIGURATION (F5)

The CONFIG key causes the CONFIGURATION LIST to be displayed again.

COLLECT (F6)

The COLLECT key initiates a new data collection.

5.3 16 CHANNEL TIMING MENU (1000 words, 200 MHz Max.)

A. TO CALL MENU:

1. Press the CONFIG or RESET key.
2. Press soft-key labeled SEL DOWN or SEL UP as appropriate to move the cursor to the 16 CHANNEL TIMING position.
3. Press F1 to select the TIMING menu.
4. Place cursor in CLOCK field.

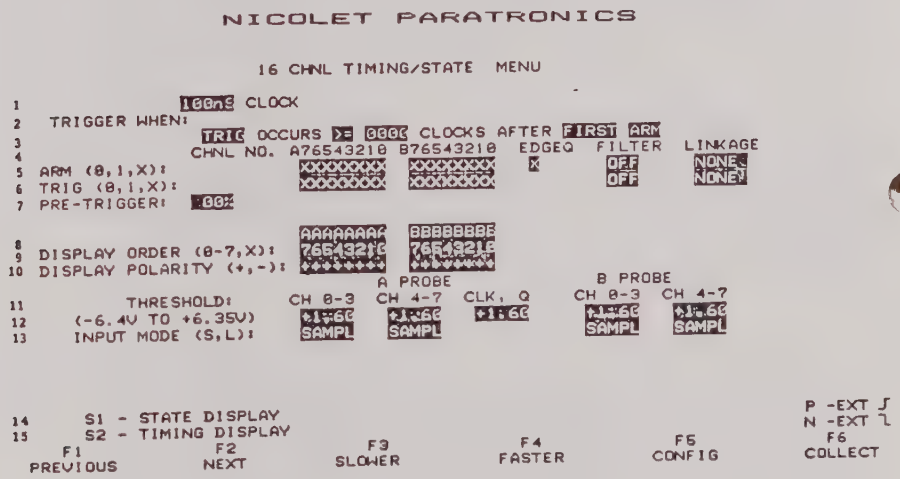

Figure 5-5. 16-Channel Timing Menu.

B. EXPLANATION OF MENU:

CLOCK SELECT

Line 1: Clock sampling interval (internal clock) or clock polarity and qualifier (external clock). Clock speed is selected using the SLOWER (F3) and FASTER (F4) keys. External clock polarity is selected by P, for positive edge, or N, for negative edge. If an external clock is selected, the CLOCK QUALIFIER field is displayed, allowing selection of 1, 0, or X for the external clock qualifier bit.

TRIGGER MODE

Lines 2 and 3: Triggering modes. Use the NEXT or PREVIOUS keys to access the TRIGGER MODE field as indicated by the small, flashing cursor. Then use the SELECT key to call the desired mode. The possible modes are described in detail in Section 8.0.

Within each mode, use the NEXT and SELECT keys to change TRIG to TRIG, to to =, ARM to ARM, FIRST to LAST, and AFTER to BEFORE. In order to change the clock delay value, use the NEXT key to step to the DELAY field. Then use the numeric keys to set up the clock delay.

CHNL NO.

Line 4: Headers for the CHANNEL NUMBER, FILTER, EDGE QUALIFIER and LINKAGE fields.

ARM, FILTER, LINKAGE

Line 5: In the ARM field, the combinatorial logic values (0,1,X) will arm (enable) the analyzer for triggering. The EDGE QUALIFIER field (EDGEQ) is used to qualify the ARM or TRIGGER word. Field entries can be . The input for this function is channel 33 on the timing probe. FILTER sets the number of consecutive clock sample intervals (2-9) during which the ARM word must be stable before it is accepted. (NOTE: Use of 0 or 1 will turn the filter off which is equivalent to a default value of 1.) When in the LINKAGE field, press the SELECT key to set up the NPC-700 for linking to other analyzers, to the State (L) or Waveform (W) Sections, or to an external input (E).

TRIG, FILTER, LINKAGE

Line 6: Similar to Line 5 except that these parameters set up the conditions associated with the trigger word.

NOTE: In order for the analyzer to complete a data collection, the delay relationship between arm and trigger specified in Line 3 must be completely satisfied.

PRETRIGGER (0-9)

Line 7: Specifies percentage (0-90%) of data to be collected prior to trigger point. 00% pretrigger is the default value. To ensure data collection, note that the NPC-700 does not require that the full amount of pretrigger data be collected before the trigger condition becomes satisfied, so that the amount of data actually preceding the trigger point can be less. However, the amount of data following the trigger point will always be constant for a given pretrigger value.

DISPLAY ORDER (0-7, X)

Lines 8 and 9: Specifies the order in which the collected timing channels appear in the display. The labels A and B correspond to 8-bit data groups coming through the A and B probes. An X blanks out a line, and the numbers 0-7, entered in any order (or even repeated), set up the display order within the probe group.

DISPLAY POLARITY (+,-)

Line 10: Use of the + or - keys here will display a TRUE or COMPLEMENTED timing diagram, respectively.

THRESHOLD (-6.4V to +6.35V)

Lines 12 and 13: These fields allow the keyboard selection of thresholds at the input to each 8-channel probe. Thresholds are settable in 50 mV increments anywhere in the specified range by pressing the appropriate numeric data entry keys. Note that the default value is +1.60V for TTL logic.

DELETE SAMPLE OR LATCH

Line 13: Input channels can be set to only sample data or to latch any transition in between samples (glitch detection).

STATE/TIMING DISPLAY

Lines 14 and 15: Show that using keys S1 and S2 will bring state or timing data to the screen.

EXTERNAL CLOCK

Lines 14 and 15: On the right-hand side of screen using the P or N keys will set an external clock when in the clock field. P will give a rising edge and N a falling edge clock.

5.3.1 16-CHANNEL TIMING DISPLAY (1000 words, 50 MHz)

A. TO CALL DISPLAY:

COLLECT (F6)

1. Press the COLLECT key to perform a data collection. (One or more probes must be connected to the test card or a circuit-under-test to collect data.)

S1
S2

2. Press S1 to display equivalent state data; press S2 for equivalent timing data.

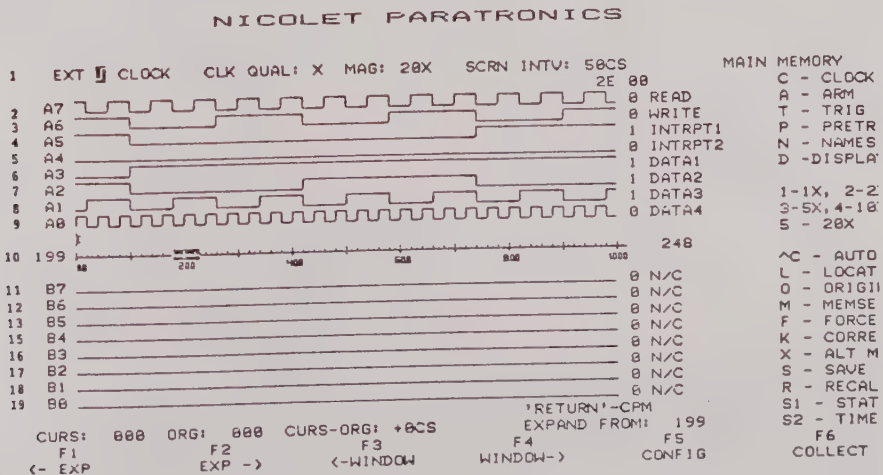

Figure 5-6. 16-Channel Timing Display using an external clock, 0% pretrigger, and 20X magnification. The Logic Analyzer Test Card is the source.

B. EXPLANATION OF THE 16-CHANNEL TIMING DISPLAY:

CLOCK, MAG, SCRN INTV, MAIN/AUX

Line 1: Displays the clock sampling interval (internal clock) or clock polarity and qualifier (external clock), the magnification factor, and the screen interval. (FOR INTERNAL CLOCK OPERATION, THE SCREEN INTERVAL = CLK PERIOD X 1000 SAMPLES - BY MAGNIFICATION FACTOR; FOR EXTERNAL CLOCK OPERATION, THE SCREEN INTERVAL = NUMBER OF CLOCK SAMPLES.) Also displayed is the MAIN/AUX memory identifier.

HEX VALUE

Line 2: Data in hexadecimal at current cursor location. The hexadecimal cursor value is affected by the display order.

TIMING DIAGRAMS

Lines 3-10 and 14-21: Displays all 16 channels of timing data in two groups of 8. The cursor is used to measure time between events. The value of the corresponding data in binary at the current cursor location is displayed at the right end of each timing trace. Note that the NPC-800 provides a unique "shaded" display for those timing diagrams whose transitions are occurring too close together to be resolved at lower screen magnifications. This feature reduces the possibility of making erroneous visual time measurements. Shaded areas are always resolved into discrete lines at X10 or X20 magnification factors.

EXPANSION INDICATOR (E)

Line 11: This indicator can be moved anywhere within the screen by pressing the EXPAND keys -EXP or EXP- . It is used to locate an area in the current screen that requires additional magnification. Expansion is always to the right of the indicator.

GRATICULE

Line 12: The graticule shows the range and position in inverse video (relative to the entire 1000-word data collection) of the current display. The trigger point is shown as an intensified numeric label on the graticule. The numbers at the left and right-hand sides of the graticule indicate the boundary values of the displayed data.

CURS, ORG, CURS-ORG, EXPAND FROM

Line 23: Displays the numeric values for the current location of the cursor, the current location of the origin, the difference in time or clock samples between the cursor and origin, and the expansion indicator location.

-EXP, EXP- (F1, F2)

Line 25: The -EXP and EXP- keys move the expansion cursor, E, back and forth on the screen. Note that the expansion cursor cannot be moved off the screen. The expansion cursor does not appear in the waveform display; however, the EXPAND functions are still valid.

-WINDOW, WINDOW- (F3, F4)

The -WINDOW and WINDOW- keys are used to select the portion of the data collection currently being displayed. This window, and its position in the data memory, are shown by the inverse video portion of the graticule below the waveforms on the screen. Note that at any expansion factor other than X1, all of the data memory cannot be displayed at one time. For these larger expansion factors, pressing either WINDOW key will step or sweep (using REPEAT) the window so that the entire data collection can be viewed. Moving the window to the left, for example, causes the displayed data to move from left to right.

CONFIG (F5)

Pressing the CONFIG key, F5, causes the CONFIGURATION LIST to be displayed again.

COLLECT (F6)

Pressing the COLLECT key, F6, initiates a new data collection.

LABELS

Lines 2 to 23: Prompting messages can be accessed (after a data collection is displayed) by pressing the LABELS key. It identifies all direct entry functions.

C-CLOCK
A-ARM
T-TRIG
P-PRETRG
D-DISPLAY

Lines 2 to 6: These keys call the TIMING menu, with the cursor located in the particular field selected by each key. For example, T will place the cursor in TRIGGER field of the menu. Other fields can then be accessed by using PREVIOUS or NEXT. Also, S2 can be pressed to call the data again.

N-NAMES

Line 7: The N key places a cursor at the right of the timing diagram display for the generation of an 8-character alphanumeric label for each channel. These labels are defined by the user to identify and document displayed signals. Pressing the ESC key terminates the NAME mode.

1-1X
2-2X
3-5X
4-10X
5-20X

Lines 9 to 13: The numeric keys 1, 2, 3, 4, and 5 expand the timing (and waveform) displays by the indicated factor. Expansion occurs from the right of the current position of the expansion cursor, which is represented on the screen by the symbol E. When expansion occurs, the expansion cursor will normally be positioned to the far left of the screen. The exact position of the expansion cursor is indicated on the screen in the EXPAND FROM field.

L-LOCATE (CURSOR)

Line 14: L is used rapidly to bring the timing cursor onto the left-hand edge of the screen. This is useful when the cursor's present location is away from the present window of data being viewed.

O-ORIGIN

Line 15: O is used to simplify time measurements with the cursor. Pressing this key causes the current position of the cursor to become the ORIGIN. In the waveform mode, the voltage at the current cursor position also becomes the ORIGIN value. Moving the cursor from this position then causes differences in time (and voltage) between cursor and origin values to be displayed.

M-MEMSEL

Line 16: **M**, MEMSEL, selects the MAIN or AUXILIARY memory for display.

K-CORREL

Line 17: The K key is used to calculate the correlation (figure of merit) between the current data collection in the main memory and the reference data in the auxiliary memory. The computation is performed independently for each active channel. Total bit-for-bit correspondence results in a correlation of 1.000 being displayed. A one-bit difference, for example, reduces the correlation to 0.999. For a correlation example, see Section 6.2.2.

NOTE: When the **K** key is pressed, the correlation values replace the timing diagram names. Press **S2** to return the names.

F-FORCE

Line 18: If the **COLLECT** key has been pressed, but triggering conditions have not been met (or if the collection is only partially complete), **F**, the **FORCE DISPLAY** key, stops the data collection process and causes captured data to be displayed. The last data word collected is automatically defined as the trigger point. Pressing the FORCE DISPLAY key allows the prior 999 words to be viewed, regardless of the setting of the pretrigger field. (In the 8 CHANNEL TIMING mode, the prior 1999 words are displayed.)

X-ALT M

Line 19: The **X** key causes the display to automatically alternate between MAIN and AUX.

S-SAVE*

Line 20: After a data collection has been made, pressing the S key saves the contents of the main memory into the auxiliary memory. Included with the saved data is the set of menu parameters and test codes used to obtain the data collection.

R-RECALL*

Line 21: Pressing the **R** key recalls the menu information and data stored in the auxiliary memory with the **SAVE** key. This function allows a previous test to be repeated without having to re-enter parameters. Note: Pressing the **RECALL** key causes the current menu parameters to be lost.

S1-STATE

Line 22: The S1 key allows the user to select the state equivalent of the timing diagram or analog waveform displays. Pressing **S1** will again call the timing display.

S2-TIME

Line 23: The S2 key returns the timing display.

CURSOR RIGHT,
CURSOR LEFT

The **SPACE BAR** and **BACK SPACE** keys step the timing cursor right or left, respectively, through the data collection.

As the cursor moves, its current position is indicated on the screen. The cursor measures the time between events in the data collection and can be used in conjunction with the ORIGIN function. Note that even if the cursor is off-screen, its position is still indicated correctly. Also note that the binary value corresponding to the state of each input line at the cursor appears at the right-hand-side of the screen. The associated hexadecimal value corresponds to all channels in the memory, whether they are displayed or not. The binary and hexadecimal values will change when the display order is modified in the menu. (The general rule that applies here is: "What you see is what you get.") In the waveform mode, the voltage at the cursor position is also displayed.

***NOTE:** These commands provide temporary data storage/recall functions using the internal AUX RAM. The disk is not required for these functions.

5.3.2 16-CHANNEL STATE DISPLAY

A. TO CALL DISPLAY:

COLLECT
S1

1. Press the **COLLECT** key to perform the data collection.
2. If data have been collected and are displayed in the timing format, press **S1** to call the state display.
3. Press the **LABELS** key, then press one of the display format keys. (Hexadecimal is used in this example.)

Figure 5-7. 16-Channel State Display.

B. EXPLANATION OF THE 16-CHANNEL STATE DISPLAY:

MAIN (AUX)

Line 1: **MAIN (AUX)** memory identifier, location of trigger word (this example).

LOC

Line 3: TRIGGER word locator field.

SIG

Lines 5 and 6: Test codes (SIG) of data collection.

DATA

Lines 1 to 20: Word number and associated data for 20 of the 1000 words (max) collected in this mode. Note that the display is formatted in accordance with the **H, O, Z, N,** or **Y** key used. The data order is A7-A0, B7-B0, and is fixed.

SCRL DWN (F1)
SCRL UP (F2)
LOCATE (F3)

Line 25: The **SCRL DWN (BACKSPACE)** and **SCRL UP (SPACEBAR)** keys, as described earlier, allow different segments of data to be viewed.

The **LOCATE** key is used to position the cursor at the LOC field in the state display. After pressing the LOC key, the user enters a + or - followed by a three-digit number that represents the word location in memory relative to the trigger word. Pressing **LOCATE** and **T** places the trigger word at the top of the screen; pressing **LOCATE** and **B** places the beginning of the state collection (not necessarily the trigger word) at the top of the screen; pressing **LOCATE** and **E** places the end of the collection at the bottom. Pressing **LOCATE** and **D** when using the DIFFERENCE mode places the first full-intensity difference line at the top of the screen. Repeating **LOCATE** and **D** will move the next difference word to the top of the display. Pressing **LOCATE** and **S** places the first half-intensity "same" word at the top of the screen.

TIMING (F4), S2

The **TIMING** key calls the timing display, as does **S2.**

LABELS

Lines 10 to 23: The menu for manipulating timing data is displayed by pressing the **LABELS** key.

DIRECT KEYS

C AUTO

C will put the analyzer into AUTOMATIC TRIGGER mode where it will repeatidly trigger until stopped by press the **M** key.

C, P, or T
C-CLOCK QUAL
P-PRETRG
T-TRIG

will cause the menu to be displayed, with the cursor in the field: CLOCK QUALIFIER, PRETRIGGER, or TRIGGER.

M-MEMSEL

M will alternate the display between the **AUX** and MAIN memories.

S-SAVE

S will write MAIN memory data into AUX memory.

R-RECALL

R will write AUX memory data into MAIN memory.

DISPLAY FORMAT

H, O, Z, N, Y, or U will display all data in the single format selected.

NOTE: The HEX, OCT, DEC, BIN, ASC, and USER formats serve two basic functions: When used within a menu, the bits in each data entry field are grouped into digits corresponding to the selected format; when used with displayed data, they control the format used.

H - HEX — Causes state data or a data entry field to be displayed in a hexadecimal format.

O - OCT — Causes state data or a data entry field to be displayed in an octal format.

Z - DEC — Causes state data or a data entry field to be displayed in a decimal format.

N - BIN — Causes state data or a data entry field to be displayed in a binary format.

Y - ASC — Causes state data to be displayed in a 7-bit ASCII format. (Leading bits are ignored.)

5.4 8-CHANNEL TIMING MENU

A. TO CALL MENU:

1. Press the **CONFIG** or **RESET** key.
2. Press the **SEL DOWN** or **SEL UP** key to move the cursor to the 8 channel timing position.
3. Press the **TIMING (F1)** key to call the TIMING menu.

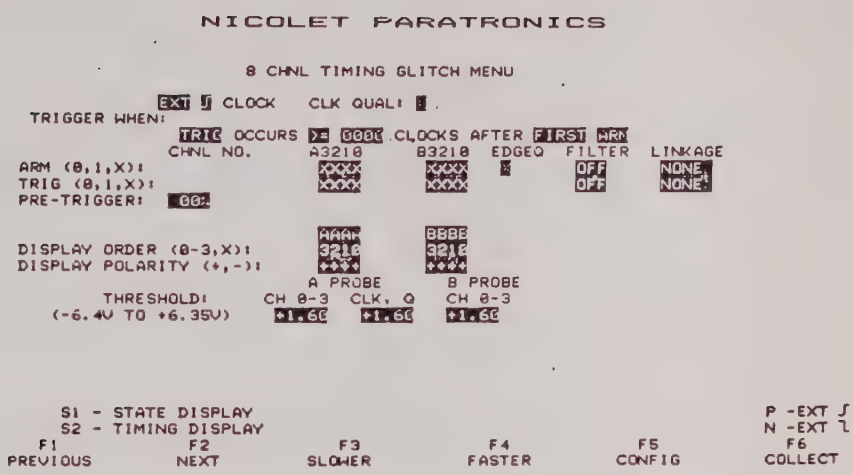

Figure 5-8. 8-Channel Timing Menu.

B. EXPLANATION OF THE MENU:

CLOCK SELECT

The 8-channel timing menu is virtually identical to the 16-channel menu described in Section 5.3 except that only the fields associated with the A timing probes are valid. The sample/latch mode is omitted since this mode is a special glitch capture configuration.

NOTES:
1. The B probe must be disconnected for this mode.
2. When using an external clock, data words are recorded on both clock edges, independent of the edge selected.

5.4.1 8-CHANNEL TIMING DISPLAY

A. TO CALL DISPLAY:

COLLECT
S2

1. Press the **COLLECT** key to perform a data collection.
2. If data have already been collected, but displayed in the state format, press the **S2** or the **TIMING (F4)** key.

NOTE: Although an internal sampling clock was used in this example, an external clock (rising or falling edge) and qualifier (0,1,X) could have been used as well.

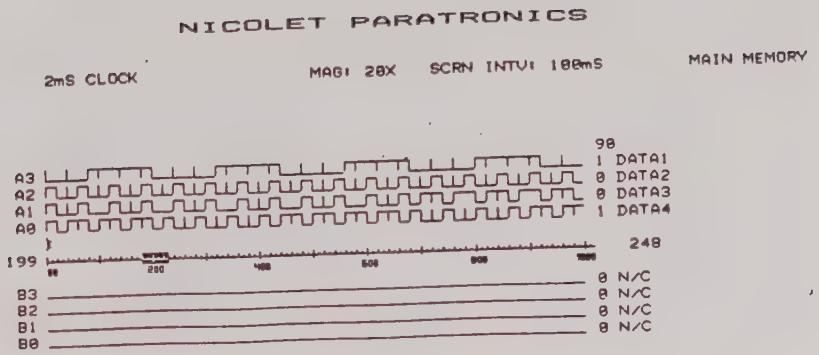

Figure 5-9. 8-Channel Timing Display.

B. EXPLANATION OF THE 8-CHANNEL TIMING DISPLAY:

The 8-channel timing display is similar to the 16-channel timing display described in Section 5.3.1

5.4.2 8-CHANNEL STATE DISPLAY

COLLECT
S1

A. TO CALL DISPLAY:

1. Press the **COLLECT** key to perform the data collection.
2. If data have been collected and are displayed in the timing format, press **S1** to call the state display.
3. Press one of the display format keys. (Hexadecimal is used in this example.)

Figure 5-10. 8-Channel State Display.

B. EXPLANATION OF THE 8-CHANNEL STATE DISPLAY:

The 8-channel state display is similar to the 16-channel state display described in Section 5.3.2.

5.5 WAVEFORM MENU (1000 WORDS, 50 MHz)

A. TO CALL UP MENU:

1. Press the **CONFIG** or **RESET** key
2. Press the **SEL DOWN** or **SEL UP** to select the WAVEFORM RECORDER mode.
3. Press the **WAVEFORM (F1)** key to call the menu.

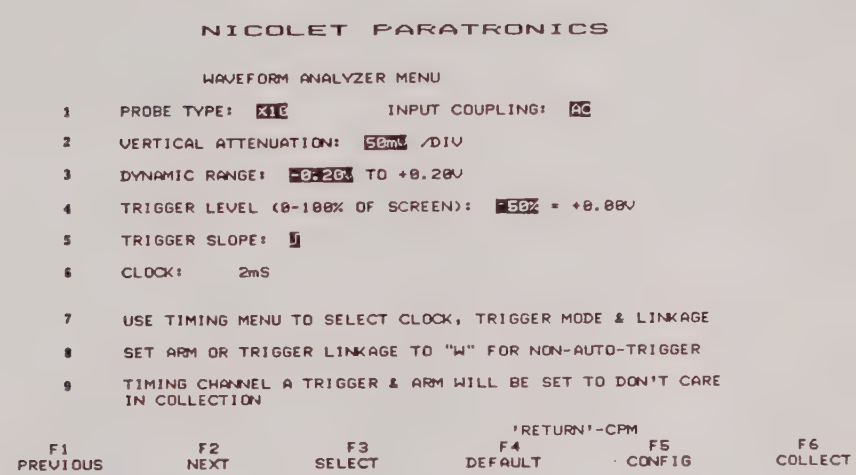
NICOLET PARATRONICS
WAVEFORM ANALYZER MENU
1 PROBE TYPE: X10 INPUT COUPLING: AC
2 VERTICAL ATTENUATION: 50mV /DIV
3 DYNAMIC RANGE: -0.26V TO +0.20V
4 TRIGGER LEVEL (0-100% OF SCREEN): 50% = +0.00V
5 TRIGGER SLOPE: ⌋
6 CLOCK: 2mS
7 USE TIMING MENU TO SELECT CLOCK, TRIGGER MODE & LINKAGE
8 SET ARM OR TRIGGER LINKAGE TO "W" FOR NON-AUTO-TRIGGER
9 TIMING CHANNEL A TRIGGER & ARM WILL BE SET TO DON'T CARE IN COLLECTION
'RETURN'-CPM
F1 PREVIOUS
F2 NEXT
F3 SELECT
F4 DEFAULT
F5 CONFIG
F6 COLLECT

Figure 5-11. Waveform menu.

B. EXPLANATION OF MENU:

Line 1: PROBE TYPE (X10,X1). This field configures the waveform analyzer for the type of probe used. INPUT COUPLING. DC, AC, GND.

Line 2: ATTENUATOR. 5mV/DIV to 20V/DIV (X1 probe). 50mV/DIV to 200V/DIV (X10 probe).

Line 3: DYNAMIC RANGE. Select the lower value to position the voltage window. Input waveforms within this range will be digitized by the A/D converter without saturation.

Line 4: TRIGGER LEVEL. Threshold level for incoming waveform to cause analyzer to trigger.

Line 5: TRIGGER SLOPE. Rising or falling. This is the slope of the waveform at the threshold crossing which is required for triggering.

Line 6: The value of the sampling rate. Note this parameter is set in the timing menu.

Lines 7-9: Instructions to use timing menu to set up sample clock, trigger mode (including pretrigger), and linkage. For threshold and slope parameters of the waveform menu to be active, a W must be set into the linkage portion of the ARM or TRIG field; otherwise, the waveform analyzer operates in an auto-trigger (free-running) mode when **COLLECT** is pressed.

5.5.1 WAVEFORM DISPLAY (1000 words, 50 MHz)

A. TO CALL DISPLAY:

1. Press the **COLLECT** key to perform a data collection.
2. Press the **D** key once for raw sample points. Press the **D** key a second time for unconnected, software interpreted values. Press the **D** key a third time to return to a software-smoothed display.

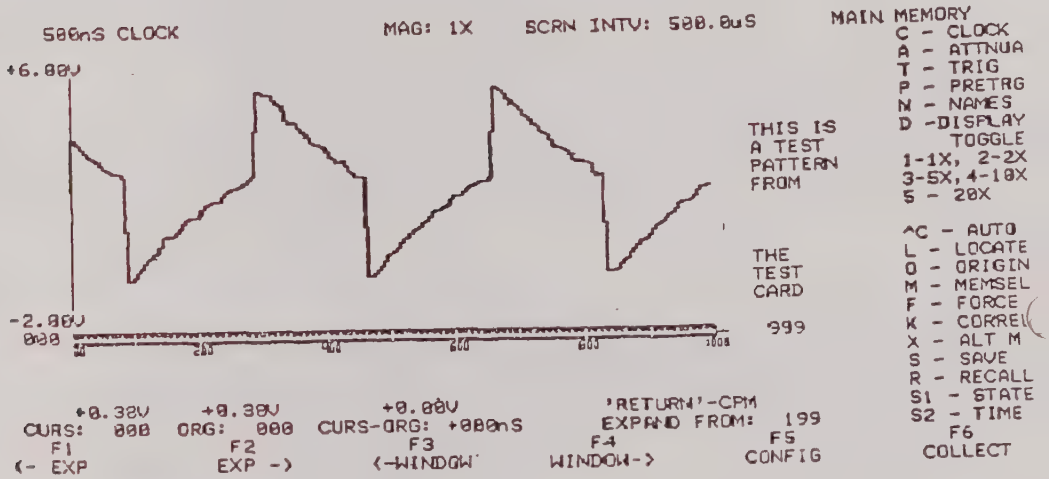

Figure 5-12. Waveform display.

B. EXPLANATION OF WAVEFORM DISPLAY:

Line 1: Displays the internal (or external) clock sampling interval, the magnification factor, the screen interval, and the MAIN/AUX memory.

Line 3: Displays the most positive voltage of the measurement window at the left.

Line 17: Displays the most negative voltage of the measurement window at the left.

Line 18: Displays the inverse video graticule which shows the range and position (relative to the entire 1000-sample data collection) of the current display. The trigger point is intensified.

Line 22: Displays the voltage at the cursor, the voltage at the origin, and the voltage difference between the cursor and the origin. (Measurement accuracy is ±3%.)

Line 23: Displays the current location of the cursor, the current location of the origin, the difference in time between the cursor and origin values (for time measurement), and the expansion factor location.

NOTE: The expansion symbol, E, used in the timing display is not available in the waveform display. However, the **EXPAND FROM:** indicator is still valid.

Lines 2-23: Direct entry and display manipulation keys.

Lines 24 and 25: Soft-key identifiers and labels.
Lines : Text which can be entered by the user to describe the data. Use **N** key as with the timing diagram labeling.

5.5.2 STATE VERSION OF WAVEFORM DISPLAY

A. TO CALL DISPLAY:

1. Press the **COLLECT** key to perform the data collection.
2. Or if data have been collected, press the **S1** key.
3. Press the **BIN (N)** key.

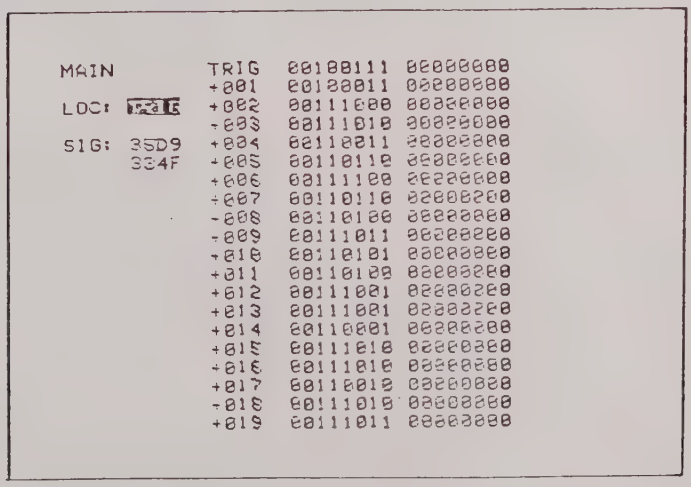

Figure 5-13. Binary values of waveform samples.

B. EXPLANATION OF THE STATE VERSION OF THE WAVEFORM DISPLAY:

The state version of the waveform display is similar to the 8-channel state display. However, for the waveform analyzer, the binary words represent the instantaneous voltage values at the sample points of the incoming analog signal. (Since the waveform analyzer uses a 6-bit A/D converter, the two MSB's in the 8-bit display are always 0.)

5.5.3 WAVEFORM DISPLAY MAGNIFICATION CONCEPTS

X1 For this magnification factor, each point of the waveform display represents 5 samples of data in the timing memory. The software takes the first valid sample (i.e., the fourth sample), then scans subsequent sets of 5 samples each, choosing the sample with the largest deviation from the last point displayed. This procedure continues until 997 samples in memory are processed.

X2 For X2 magnification, the display process is similar to X1 magnification, except that only 500 samples of timing memory are scanned in alternating groups of 2 and 3 samples.

X5 Here, 200 samples of the timing memory are used to display 200 waveform points on the screen. A filtering algorithm is used to smooth the data at X5 and higher magnifications.

X10 Here, 100 samples of the timing memory are used to generate 200 waveform points on the display. The interpolated points are calculated by the linear interpolation algorithm. Furthermore, the filtering algorithm mentioned previously is also utilized.

X20 Here, 50 samples of the timing memory are used to generate 200 points of waveform data. Each bit of timing memory generates 4 points on the display. A linear interpolation method is used for the interpolated points; then it is smoothed by the filtering algorithm.

5.5.4 ALIASING

Aliasing occurs when a high frequency waveform appears on the display as a low frequency waveform due to an insufficient sample rate (i.e., below the Nyquist limit).

To avoid aliasing, as a **conservative** rule of thumb, always sample at 5 to 10 times faster than the highest frequency component of the incoming waveform.

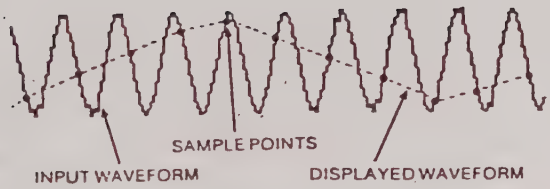

Figure 5-14. **Example of aliasing. Notice that the high frequency waveform is displayed as a low frequency "alias."**

5.6 COUNTER-TIMER MENUS

Three illustrative counter-timer menus are shown below:

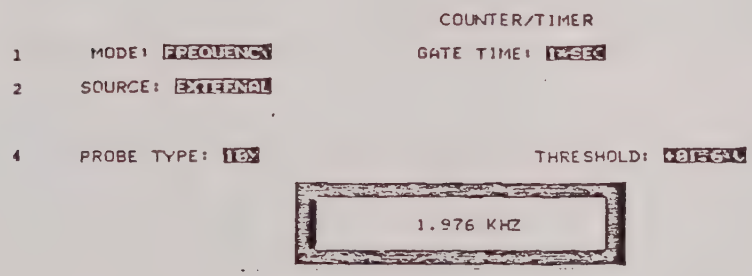

Figure 5-15. **Frequency mode with external as source. (Using Model 90 probe.) (The total mode is similar.)**

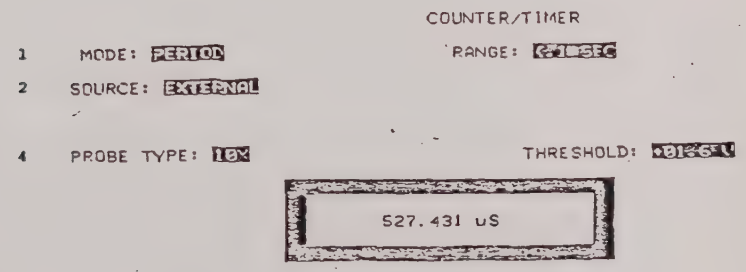

Figure 5-16. **Period mode with data as source. (Using state probes.) (The total mode is similar.)**

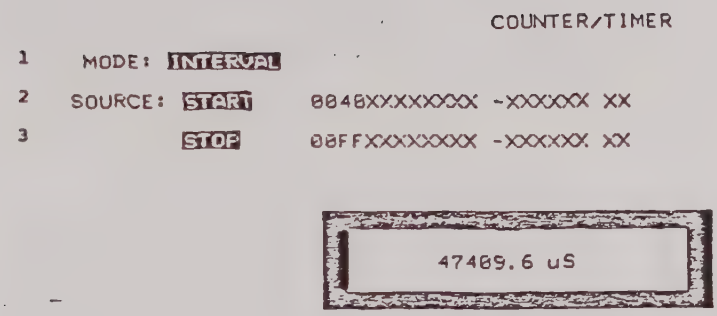

Figure 5-17. Interval mode with start and stop words as source.

A. TO CALL UP MENU:

1. Press the **CONFIG** or **RESET** key.
2. Press the **SEL DOWN** or **SEL UP** key to select the COUNTER-TIMER mode.
3. Press the **SELECT (F1)** key to call the menu.

B. EXPLANATION OF MENU:

Line 1: **MODE.** The user can select from the following counter-timer modes: FREQUENCY, PERIOD, INTERVAL, and TOTAL. Measurements can be made of individual signals using the Model 90 scope probe or of state events using the analyzer's 16-channel state probes.

The **FREQUENCY** mode can measure individual signals up to 100 MHz using the Model 90 probe, or state events up to 10 MHz using the 16-channel state probes.

The **PERIOD** mode is the inverse of the **FREQUENCY** mode.

The **TOTAL** mode measures the total number of occurrences of single events monitored by the Model 90 probe, or state events monitored by the 16-channel state probes.

GATE TIME: Used in the FREQUENCY mode only. The GATE TIME is the time interval over which the frequency is measured and can be selected from 10 msec to 10 seconds.

RANGE: Used in the PERIOD MODE only. The RANGE is the maximum period which can be measured and can be selected from 10 msec to 10 seconds.

Lines 2 & 3: **SOURCE:** In the FREQUENCY, PERIOD, AND TOTAL modes, the SOURCE field can be selected as EXTERNAL (Model 90 probe), PRESCALE (EXTERNAL/10), or DATA (state probes). The PRESCALE mode must be selected for measurements above 10 MHz (100 MHz maximum). For the NPC-764, the DATA mode allows measurements to be made on state events up to 56 bits wide. (38 bits wide for the NPC-748.)

In the INTERVAL mode, the SOURCE field allows the specification of START and STOP words, each 38-56 bits wide.

Line 4: **PROBE TYPE:** This field is displayed only in the FREQUENCY, PERIOD, and TOTAL modes--and only when the SOURCE field is EXTERNAL or PRESCALE (EXT/10). The two options are 10X and 1X, according to the setting of the Model 90 probe.

THRESHOLD: This field is available only when the PROBE TYPE field is displayed. When a 10X probe type is selected, the threshold for an incoming signal can be set between -2.56V and +2.54V, in 0.2V increments. When a 1X probe type is selected, the threshold can be set between -2.56V and +2.54V, in 0.02V increments.

5.6.1 COUNTER-TIMER DISPLAY

The counter-timer display is incorporated into the menu. To take a measurement of a signal, simply connect the appropriate probe(s). The frequency, time, or count of input events will appear in the rectangle on the screen. Also, the message COLLECTING appears below the reading to indicate the real-time nature of the current measurement. To "freeze" the measurement, press the **HOLD (F4)** key; the message HOLDING will then appear below the reading.

5.7 SIGNATURE MENU

A. TO CALL UP MENU:

1. Press the CONFIG or RESET key.
2. Press the SEL DOWN or SEL UP key to select the SIGNATURE ANALYZER mode.
3. Press the SELECT (F1) key to call the menu.

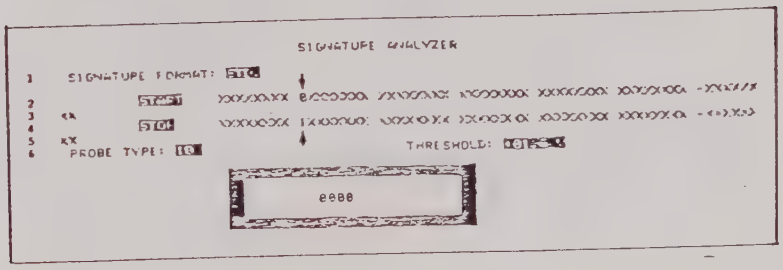

Figure 5-18. Use of single bit START and STOP words.

B. EXPLANATION OF MENU:

Line 1: **SIGNATURE FORMAT.** Two formats can be selected: STD or HEX. The STD format uses the 7-segment alphanumeric type of display of the HP-5004A Signature Analyzer (0-9, A, C, F, H, P, U). The HEX format displays the signatures in hexadecimal (0-9, A-F).

Lines 2-5: **START and STOP.** The START and STOP words gate the serial bit stream coming through the Model 90 probe. A logic zero in any bit position corresponds to ( ) on the HP-5004A; while a logic one corresponds to ( ).

The START and STOP words are automatically formatted in accordance with the user's display format in the 48-channel state menu. A single format can be selected using the HEX, OCT, BIN, DEC, or ASC keys.

Line 6: **PROBE TYPE:** The two options are 10X and 1X to match the corresponding setting of the Model 90 probe.

THRESHOLD: When a 10X probe type is selected, the threshold for an incoming signal can be set between -25.6V and +25.4V, in 0.2V increments. When a 1X probe type is selected, the threshold can be set between -2.56V and +2.54V, in 0.02V increments.

NOTE: In typical application, the clock used in conjunction with the serial bit stream being monitored should be derived from the A state probe. Set this clock for a rising or falling active edge in the state menu as appropriate. Make sure the B (and C) clock fields are set to A.

5.7.1 SIGNATURE DISPLAY

The signature display is incorporated into the menu. To take a signature of a serial bit stream being monitored by the Model 90 probe, simply touch the probe to the node and press the COLLECT key.

5.8 SERIAL ANALYZER

The NPC-800's serial testing capabilities require the use of the Model 70 Serial Probe. With this probe, **RECEIVE, EDIT** and **TRANSMIT** functions are possible. In the **RECEIVE** mode, the Model 70 converts incoming serial data to parallel words for collection by the state analyzer. Captured data can be displayed in ASCII or any other available format. In order to display received data in the menu in Figure 5-19, you must first transfer the collected data from the main state ASCII memory to the auxiliary memory. This is accomplished by pressing the S **(SAVE)** key after the data collection.

The **EDIT** and **TRANSMIT** modes operate on whatever ASCII characters are in the data field shown in Figure 5-19. The instructions for using these modes are contained in the menu itself. For additional details, consult the **Model 70 User's Instructions,** available from your nearest NPC sales office.

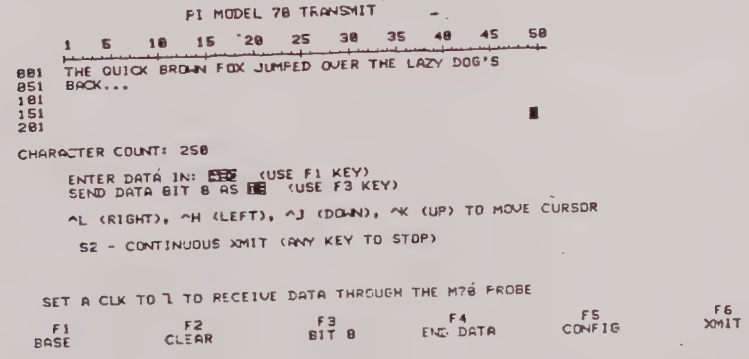
F1 MODEL 70 TRANSMIT
1 5 10 15 20 25 30 35 40 45 50
001 THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG'S
051 BACK...
101
151
201
CHARACTER COUNT: 250
ENTER DATA IN: (USE F1 KEY)
SEND DATA BIT 8 AS (USE F3 KEY)
^L (RIGHT), ^H (LEFT), ^J (DOWN), ^K (UP) TO MOVE CURSOR
S2 - CONTINUOUS XMIT (ANY KEY TO STOP)
SET A CLK TO ↑ TO RECEIVE DATA THROUGH THE M70 PROBE
F1 BASE
F2 CLEAR
F3 BIT 8
F4 END DATA
F5 CONFIG
F6 XMIT

Figure 5-19. The Model 70 EDIT and TRANSMIT menu.

NOTE: The cursor commands shown in the menu: CTRL L (RIGHT) and **CTRL H** (LEFT), are used when the data entry base is hexadecimal or octal. When the data entry base is in ASCII, it's easier to use the SPACEBAR and **BACKSPACE** keys for simple editing.

5.9 I/O CONFIGURATION MENU

A. TO CALL MENU:

1. Press the **CONFIG** or **RESET** key.
2. Press the **I** key.

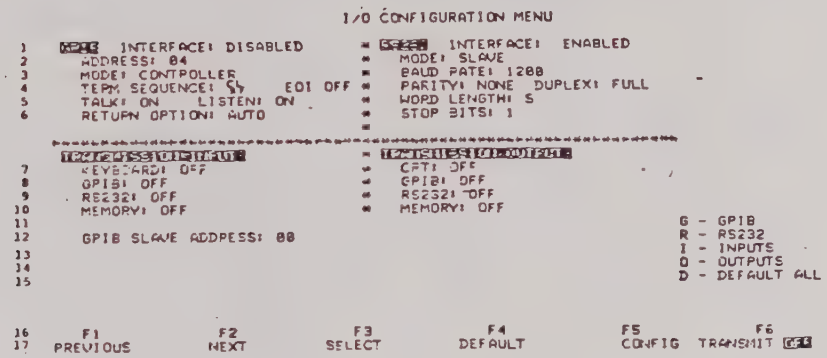

Figure 5-20. I/O Menu.

B. EXPLANATION OF MENU:

GPIB Section

INTERFACE

Line 1: The INTERFACE field defaults to ENABLED. This allows the NPC-864 to be either a CONTROLLER or DEVICE on the GPIB bus. Pressing the **SELECT** key puts the interface into a DISABLED state in which the NPC-864 is effectively disconnected from the bus.

ADDRESS

Line 2: The ADDRESS field defines the address of the NPC-864 on the GPIB bus. Pressing the **SELECT** key increments the address of the device. Valid addresses are 00 through 30 (HEX). The default address is 04.

MODE

Line 3: The MODE field determines if the NPC-864 is a DEVICE or CONTROLLER on the GPIB bus. The default condition is set by switch 2 on the DIP switch located on the Processor Board. (See Figure 12-3.) The unit is a CONTROLLER if the switch is in the OFF position. (The switch is read during power up and when the **RESET** key is pressed. See Table 5-1.) Pressing the **SELECT** key changes the MODE to DEVICE.

Table 5-1. Power Up/Reset I/O Initialization.

RS-232		GPIB	
SWITCH 1		SWITCH 2	
ON	OFF	ON	OFF
SLAVE	MASTER	DEVICE	CONTROLLER

TERMINATION SEQUENCE

Line 4: The TERMINATION SEQUENCE field defines the end of data transmission. The flashing cursor will initially be placed in the ASCII character field. Pressing the **SELECT** key changes the sequence to C_RL_F (carriage return - line feed), C_R alone, L_F alone, or NULL (no ASCII characters). If NULL is selected, EOI ON will automatically be selected and cannot be changed. If NULL is not selected, pressing the **NEXT** key will move the flashing cursor to the EOI selection portion of the TERMINATION SEQUENCE. Pressing the **SELECT** key changes EOI to ON or OFF. If EOI ON is selected, EOI will be sent out with the last character of the termination sequence previously selected or with the last character of data if NULL was selected. The default states for the TERMINATION SEQUENCE field is C_RL_F and EOI OFF.

TALK
LISTEN

Line 5: These fields determine whether the NPC-864 is a TALKER, LISTENER, or both on the GPIB bus. These fields normally default to ON. With the ON cursor flashing, pressing the **SELECT** key disables the function and sets the field to OFF.

RETURN OPTION

Line 6: The RETURN OPTION field defines the way in which the NPC-864 returns to the CP/M calling program from the ANALYZER mode. The field defaults to AUTO. Pressing the **SELECT** key changes the field from AUTO to AUTO/MAN, to MANUAL. In the AUTO mode, the return to CP/M will take place immediately after the command string has been executed by the analyzer. In the MANUAL mode, the return to CP/M will take place when the R key is pressed. (The R key is not defined in this menu.) In the AUTO/MAN mode, the return to CP/M will take place immediately after the command string has been executed by the analyzer, except when a data collection is being initiated by the command string. After data collection is completed, the return to CP/M will be the same as described above for the MANUAL mode.

RS-232 Section

INTERFACE

Line 1: The INTERFACE field defaults to ENABLED which allows the NPC-864 to communicate with other devices via an RS-232 bus. After accessing this field, pressing the **SELECT** key puts the interface into a DISABLED state which effectively disconnects the device from the bus. If the ENABLED mode is selected, the NPC-864 can either be a MASTER or SLAVE on the bus.

MODE

Line 2: The MODE field allows you to reconfigure the NPC-864 as the MASTER or SLAVE on an RS-232 bus. The default condition is set by switch 1 on the DIP switch located on the Processor Board. (See Figure 12-3.) The unit is a MASTER if the switch is in the OFF position. (The switch is read during power up and when the **RESET** key is pressed. See Table 5-1.) A third mode of operation, MASTER/ECHO, is also available. This mode is identical to MASTER, except that all commands executed by the NPC-864 are echoed from the RS-232 port (except when in the I/O configuration menu). This feature is useful when it is desired to set up the MASTER and SLAVE in the same configuration, or to simply see the SLAVE's menus when entering commands manually. The **SELECT** key changes the mode from SLAVE to MASTER to MASTER/ECHO.

Line 3: The BAUD RATE field defines the RS-232 transmission rate. The field defaults to 1200. Use the following keys to select the desired BAUD RATE:

Table 5-2. Baud Rate Select

KEY	BAUD RATE
1	110
2	150
3	300
4	600
5	1200
6	2400
7	4800
8	9600

NOTE: This information is displayed on the CRT when the BAUD RATE field is activated.

PARITY

Line 4: The PARITY field defaults to NONE. Pressing the **SELECT** key allows you to set the PARITY to NONE, ODD, EVEN, MARK, or SPACE.

DUPLEX

Line 4: The DUPLEX field defaults to FULL which enables the echo mode for the RS-232 interface. Pressing the **SELECT** key allows you to set the DUPLEX field to HALF or FULL.

WORD LENGTH

Line 5: The WORD LENGTH field defaults to 8. Pressing the **SELECT** key allows you to set the WORD LENGTH to 8, 7, 6, or 5 bits.

STOP BITS

Line 6: The STOP BITS field defaults to 1. Pressing the **SELECT** key allows you to set the number of STOP BITS to 1 or 2. Note that some combinations of parity and word length force the number of stop bits to a specific state. For example, if the word length is selected to be 8 and parity is selected, 1 stop bit is sent even though 2 stop bits may have been selected; if the word length is 5 and no parity is selected, 1.5 stop bits are sent if 2 stop bits are selected.

Transmission Inputs Section

This section defines the source(s) of data that will be sent to the interface or memory defined in the TRANSMISSION OUTPUTS section, described below.

KEYBOARD

Line 7: The KEYBOARD field normally defaults to OFF. The keyboard can only be used to configure and control the analyzer in the OFF state. With the OFF cursor flashing, pressing the **SELECT** key turns the KEYBOARD field ON to transmit data to the interface(s) selected in the TRANSMISSION OUTPUTS section.

GPIB

Line 8: The GPIB field normally defaults to OFF. If the INTERFACE field in the GPIB section of the menu is DISABLED, the GPIB field will be forced to OFF and cannot be changed. With the OFF cursor flashing, pressing the **SELECT** key turns this field ON and enables the NPC-864 to receive data from another device over the GPIB bus and send data to the destination(s) selected in the TRANSMISSION OUTPUTS section.

RS-232

Line 9: The RS-232 field normally defaults to OFF. If the INTERFACE field in the RS-232 section of the menu is DISABLED, the RS-232 field will be forced to OFF and cannot be changed. With the OFF cursor flashing, pressing the **SELECT** key turns this field ON and enables the NPC-864 to receive data from another device over the RS-232 interface and send data to the destination(s) selected in the TRANSMISSION OUTPUTS section.

MEMORY

Line 10: The MEMORY field normally defaults to OFF. If the MODE field in the GPIB section is set to DEVICE and the mode field in the RS-232 section is set to SLAVE, the field will be forced to OFF and cannot be changed. With the OFF cursor flashing, pressing the **SELECT** key will provide several combinations of memory data to be transmitted over the GPIB or RS-232 interfaces. With the field flashing, pressing the **SELECT** key allows you to select the TIMING or STATE memory to be transmitted. Pressing the **NEXT** key moves the flashing cursor to the SETUP field. With the SETUP field flashing, pressing the **SELECT** key allows you to select the memory type to be transmitted. The choices are SETUP, DATA, or AUX. Pressing the **DEFAULT** key when either field is flashing will set both fields to OFF.

Transmission Outputs Section

CRT

Line 7: The CRT field normally defaults to OFF. The CRT will display configuration menus and data collection displays in the OFF state. With the OFF cursor flashing, pressing the **SELECT** key turns the CRT ON to display data received on the interface(s) selected in the TRANSMISSION INPUTS section.

GPIB

Line 8: The GPIB field normally defaults to OFF. If the INTERFACE field in the GPIB section of the menu is DISABLED, the GPIB field will be forced to OFF and cannot be changed. With the OFF cursor flashing, pressing the **SELECT** key turns this field ON and enables the NPC-864 to transmit data to another device over the GPIB bus. The data sent will be from the source(s) selected in the TRANSMISSION INPUTS section.

RS-232

Line 9: The RS-232 field normally defaults to OFF. If the INTERFACE field in the RS-232 section of the menu is DISABLED, the RS-232 field will be forced to OFF and cannot be changed. With the OFF cursor flashing, pressing the **SELECT** key turns this field ON and enables the NPC-864 to transmit data to another device over the RS-232 interface. The data sent will be from the source(s) selected in the TRANSMISSION INPUTS section.

MEMORY

Line 10: The MEMORY field normally defaults to OFF. If the MODE field in the GPIB section is set to DEVICE and the MODE field in the RS-232 section is set to SLAVE, the field will be forced to OFF and cannot be changed. With the OFF cursor flashing, pressing the **SELECT** key will provide several combinations of memory to receive data from another NPC-864 over the interface selected in the TRANSMISSION INPUTS section. With the field flashing, pressing the **SELECT** key allows you to select the TIMING OR STATE memory to receive the data. Pressing the **NEXT** key moves the flashing cursor to the SETUP field. With the SETUP field flashing, pressing the **SELECT** key allows you to select the memory type to receive data. The choices are SETUP, DATA, or AUX. Pressing the **DEFAULT** key when either field is flashing will set both fields to OFF.

GPIB SLAVE ADDRESS

Line 12: The GPIB SLAVE ADDRESS field will be displayed only if the MODE field in the GPIB section is set to CONTROLLER. Pressing the **SELECT** key increments the address. Valid addresses are 00 through 30 (HEX). The field defines the GPIB address of another NPC-864 (or other device*) to which the data or memory block will be sent as defined in the TRANSMISSION INPUTS or OUTPUTS section.

LABELS

Lines 11 to 15: These fields are labels to define the functions of direct entry keys. Pressing **G, R, I,** or **O** will move the flashing cursor to the associated section of the menu. Pressing **D** will set every field to its default state.

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* The format of the transferred data is unique and only a NPC-800 can use it without translation.

If MEMORY input or MEMORY output is selected, the **TRANSMIT** key will initiate the data transmission. The field will show TRANSMIT ON during transmission and will change back to TRANSMIT OFF upon transmission completion.

NOTE: Only one MEMORY (input or output) is allowed to be selected. The other MEMORY will be forced to OFF.

6.1 ANALYSIS EXAMPLES

The NPC-800 was designed for ease-of-use. Upon application of power, the Analyzer's ROM-based Operating System will display the CONFIGURATION LIST illustrated in Figure 6-1. This section of the manual provides the user with examples representing operational modes from this list. This manual uses the NPC-864MSTWC for demonstrating the capabilities of the NPC-800 series. Other models within the NPC-800 series do not have all the features of the NPC-864MSTWC, therefore some examples may not apply to your instrument.

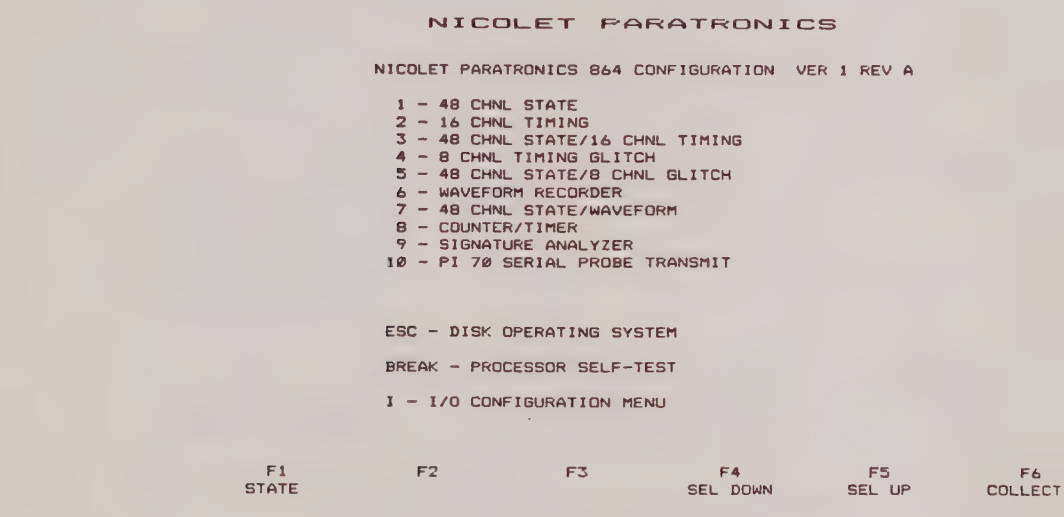
NICOLET PARATRONICS
NICOLET PARATRONICS 864 CONFIGURATION VER 1 REV A
1 - 48 CHNL STATE
2 - 16 CHNL TIMING
3 - 48 CHNL STATE/16 CHNL TIMING
4 - 8 CHNL TIMING GLITCH
5 - 48 CHNL STATE/8 CHNL GLITCH
6 - WAVEFORM RECORDER
7 - 48 CHNL STATE/WAVEFORM
8 - COUNTER/TIMER
9 - SIGNATURE ANALYZER
10 - PI 70 SERIAL PROBE TRANSMIT
ESC - DISK OPERATING SYSTEM
BREAK - PROCESSOR SELF-TEST
I - I/O CONFIGURATION MENU
F1 STATE
F2
F3
F4 SEL DOWN
F5 SEL UP
F6 COLLECT

Figure 6-1. Configuration List. (NPC-864MSTC shown)

The analysis examples in this section, are structured for progressive self-study in that each step "builds" on the previous step. The Logic Analyzer Test Card, included with each NPC-800, provides a known stimulus to the analyzer so that a given test set-up will result in a predictable response.

If you have any questions, please feel free to call Nicolet Paratronics' Applications Engineers at:

(800) 642-6538 **(Toll-free outside California)**
(415) 490-8300 **(California)**
(617) 664-0124 **(East Coast)**
(910) 381-7030 **(TWX)**

6.2 FUNCTION KEYS

The six "soft" function keys labeled F1 to F6, from left to right, are identified by labels on the bottom line of the CRT. Their functions differ from menu to menu, but as the display changes their label on the CRT changes also.

6.3 TEST CARD DESCRIPTION

The Logic Analyzer Test Card is provided to allow you and your co-workers to rapidly familiarize yourselves with the basic and advanced features of the instrument.

The Logic Analyzer Test Card consists of two 8-bit CMOS counters (A and B), a clock, and simple decoding logic. See Figure 6-2. Each CMOS counter normally counts from $(00)_{HEX}$ to $(FF)_{HEX}$. When the A counter reaches $(40)_{HEX}$, the decode logic resets the B counter to $(00)_{HEX}$.

The test card's A channel connector is wired so that the 8 least significant bits toggle in a sequential fashion; while the 8 most significant bits are tied to ground. Therefore, the A channel connector provides a 16-bit word which covers the range from $(0000)_{HEX}$ to $(00FF)_{HEX}$.

The test card's B channel connector is wired so that its 16 output bits toggle nonsequentially. A typical binary count sequence at the B channel connector is:

COUNT	BINARY PATTERN*	HEX PATTERN
0	00000000 00000000	00 00
1	10000000 00000001	80 01
2	01000000 00000010	40 02
3	11000000 00000011	C0 03
.	. .	. .
.	. .	. .
.	. .	. .
15	11110000 00001111	F0 0F

Power to the test card is supplied by the +5V output at each probe connector.

The A counter is generally used as a signal source for the one state or timing probe while the B counter output feeds the second state or timing probe. For the NPC-800, the third 16-channel state probe is not normally connected to the test card.

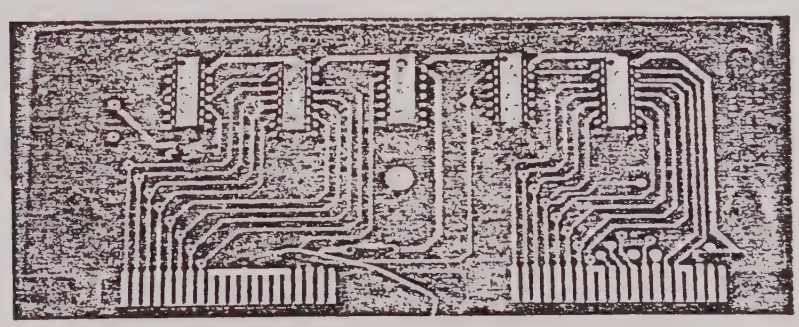

Figure 6-2. Test card layout.

NOTE:

Due to the difference in pin-outs between the 16-channel state probes and the 8-channel timing probes, this exact pattern will only be displayed on the NPC-800 when using the state probe.

6.4 STATE PROBE CONNECTIONS

In order to illustrate the basic state analysis capabilities of the NPC-800, the user need only connect the test card, select the menu, enter in a trigger word, and press the **COLLECT (F6)** key. Captured data can then be formatted in a variety of ways.

Connect two state probes, A and B, to the NPC-864MSTC. Note that the A probe connector is located toward the rear of the analyzer, leaving the C probe disconnected.

Connect the A probe to the left-hand connector of the test card and the B probe to the right-hand connector. Set the switches on both probes for **TRUE** and **TTL** operation.

6.5 STATE LOGIC ANALYSIS EXAMPLES

Turn the NPC-864MSTC's power switch on to produce the CONFIGURATION LIST illustrated in Figure 6-1. Select the STATE menu by pressing the **STATE (F1)** key. See Figure 6-3.

6.5.1 STATE MENU

The state menu parameters are defaulted to values which enable a data collection to be made without changing anything, as long as there is a clock supplied by the system under test.

To make a state data collection, simply press the **COLLECT (F6) Key.**

6.5.2 LABELS KEY

To further simplify the operation of the NPC-800, the **LABELS** key provides a list of the valid keystrokes. After pressing the **LABELS** key, observe near the top of the list that pressing **T** will return the menu display, and move the blinking cursor to the TRIGGER field.

6.5.3 TRIGGER (0040)

Press the **H** key to format this field for a hexadecimal trigger word. Now type in the following trigger word: **0040.** Observe from the labels field at the lower right corner of the CRT that other display formats can be selected using the indicated keys.

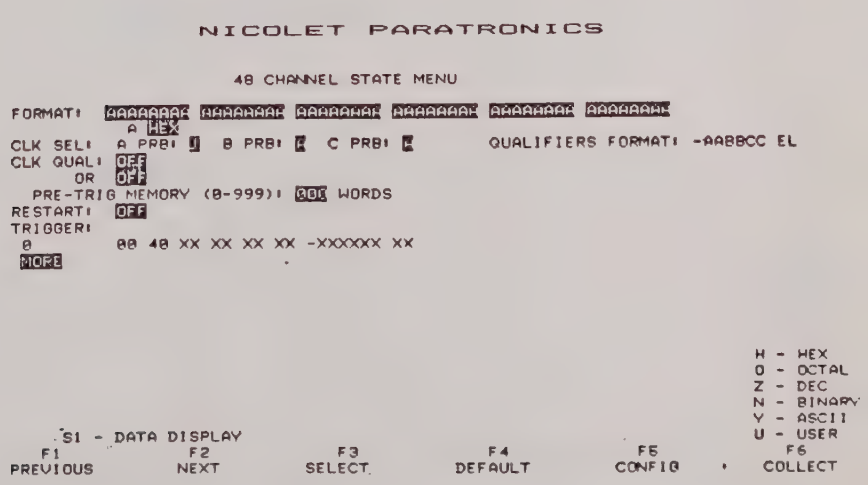

Figure 6-3. State menu with 0040 selected as the trigger word.

Press the **COLLECT (F6)** key to take a new data collection. With state data displayed, the word labeled TRIG at the top of the CRT should be **0040** for the 4 most significant digits. (Ignore the rest of the word for now.)

6.5.4 DISPLAY FORMATS

Then format the display in octal, decimal, binary, and ASCII by pressing the **O, Z, N,** and **Y** keys in turn. Press the **H** key for the hexadecimal format. See Figure 6-4.

MIXED DISPLAY FORMAT

The NPC-800 allows the user to intermix up to five different display formats. Thus, for example, you can display the address of an I/O port in HEX, the characters being output in ASCII, and the associated handshaking signals in binary. Note that you can also blank out any channel by placing an X in the appropriate bit position.

Now return to the STATE menu by pressing the **T** key use the **NEXT** or **PREVIOUS** key to move the cursor to the FORMAT field at the top of the menu, and set the display format as follows:

AAAAAAAA AAAAAAAA BBBBBBBB CCCCDDDD DDDDEEEE FFFFFFFF

A=HEX B=ASC C=BIN D=HEX E=OCT F=DEC

(H) (Y) (N) (H) (O) (Z)

Now press **S1** to return to the data display of the previous collection. The data is still displayed in the last format selected, Hexadecimal. To select the new User Defined display format, press the U key. To return to Hexadecimal format, press the H key. Pressing the U key will return.

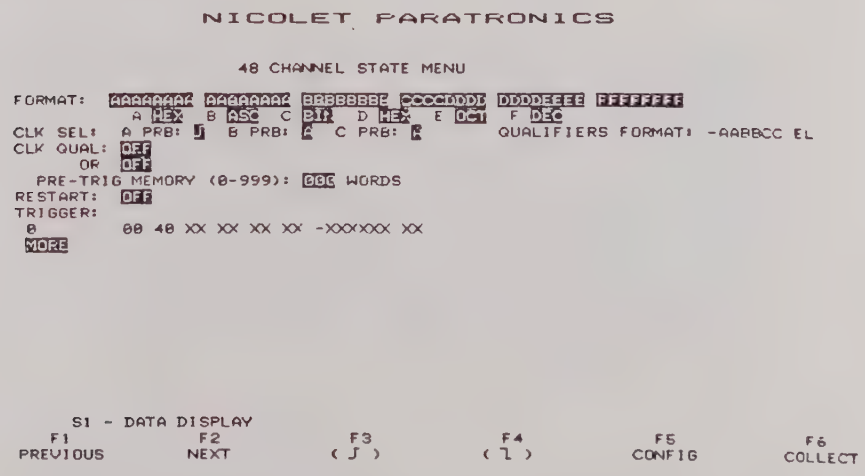
NICOLET PARATRONICS
48 CHANNEL STATE MENU
FORMAT: AAAAAAAA AAAAAAAA BBBBBBBB CCCCDDDD DDDDEEEE FFFFFFFF
A HEX B ASC C BIN D HEX E OCT F DEC
CLK SEL: A PRB: 5 B PRB: 2 C PRB: 6
QUALIFIERS FORMAT: -AABBCC EL
CLK QUAL: DEF
OR OFF
PRE-TRIG MEMORY (0-999): 000 WORDS
RESTART: OFF
TRIGGER:
0 00 40 XX XX XX XX -XXXXXX XX
MORE
S1 - DATA DISPLAY
F1 PREVIOUS
F2 NEXT
F3 (J)
F4 (1)
F5 CONFIG
F6 COLLECT

Figure 6-4. State menu for mixed format display.

6.5.5 SEQUENTIAL TRIGGERING

The NPC-800 incorporates 16 levels of sequential triggering. One application of this feature is in the tracing of deeply-nested subroutines. Use the T key to access the TRIGGER field at level 0. Press the **NEXT** key to access the END field. Then press the **SELECT** key to activate the trigger word and delay at level 1.* Set the level 1 trigger word to **0-0-4-1.** Then press the **NEXT** key to access the DELAY field. Use the **SELECT** key to view the 5 possible delay modes: AFTER 0000 CLOCKS, NOT ON 0000 CLOCKS, BEFORE 0000 CLOCKS, ON 0000 CLOCKS, and OCCURS 0000 TIMES. Select **ON 0000 CLOCKS** and enter in a delay value of **2049.** (Because the counter on the test card rolls over after 256 counts, any delay value, like 2049, that satisfies the equation:

DELAY = (N x 256) + 1, where N = an integer, will work here.)

Set up levels 2 and 3 as shown in Figure 6-5 so that the entire trigger word sequence is as follows:

LEVEL	TRIGGER WORD	DELAY
0	**0040**	**---**
1 THEN	**0041**	**ON 2049 CLOCKS**
2 THEN	**0042**	**ON 3073 CLOCKS**
3 THEN	**005A**	**AFTER 2000 CLOCKS**

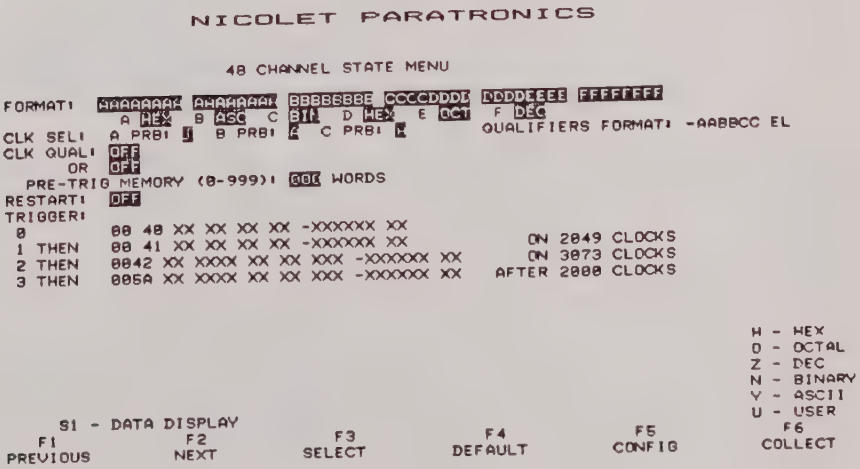
NICOLET PARATRONICS
48 CHANNEL STATE MENU
FORMAT: AAAAAAAA: AAAAAAAA: BBBBBBBB CCCCDDDD DDDDEEEE FFFFFFFF
A HEX B ASC C BIT D HEX E OCT F DEC
CLK SEL: A PRB: 0 B PRB: 2 C PRB: 4 QUALIFIERS FORMAT: -AABBCC EL
CLK QUAL: OFF
OR OFF
PRE-TRIG MEMORY (0-999): 000 WORDS
RESTART: OFF
TRIGGER:
0 00 40 XX XX XX XX -XXXXXX XX
1 THEN 00 41 XX XX XX XX -XXXXXX XX ON 2049 CLOCKS
2 THEN 0042 XX XXXX XX XX XXX -XXXXXX XX ON 3073 CLOCKS
3 THEN 005A XX XXXX XX XX XXX -XXXXXX XX AFTER 2000 CLOCKS
H - HEX
O - OCTAL
Z - DEC
N - BINARY
Y - ASCII
U - USER
S1 - DATA DISPLAY
F1 PREVIOUS
F2 NEXT
F3 SELECT
F4 DEFAULT
F5 CONFIG
F6 COLLECT

Figure 6-5. Menu used for sequential triggering example.

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* An alternative to using the SELECT key is to simply start entering data and the field will activate itself.

COLLECT

Press **COLLECT**. Note that status messages on the bottom of the display show the user how the NPC-800 is progressing through the triggering sequence. Also note how the use of a slow CMOS counter circuit in the test card and large delay values allow these messages to be readily viewed. Observe that the trigger word is **005A**, which is the last word specified in the trigger stack. See Figure 6-6.

NICOLET PARATRONICS

MAIN		TRIG	005A	0000	OF	17	255
		+001	005B	0000	OF	17	255
LOC:	TRIG	+002	005C	0000	OF	17	255
		+003	005D	0000	OF	17	255
SIG:	C077	+004	005E	0000	OF	17	255
	C08B	+005	005F	0000	OF	17	255
	D8D3	+006	0060	0000	OF	17	255
		+007	0061	0000	OF	17	255
		+008	0062	0000	OF	17	255
		+009	0063	0000	OF	17	255
		+010	0064	0000	OF	17	255
		+011	0065	0000	OF	17	255
		+012	0066	0000	OF	17	255
		+013	0067	0000	OF	17	255
		+014	0068	0000	OF	17	255
		+015	0069	0000	OF	17	255
		+016	006A	0000	OF	17	255
		+017	006B	0000	OF	17	255
		+018	006C	0000	OF	17	255
		+019	006D	0000	OF	17	255

Figure 6-6. Data collection corresponding to sequential triggering example.

6.5.6 CLOCK QUALIFICATION

Press the **LABELS** key and note that the C key will step you to the first (top) CLOCK QUAL field, which is currently off. After pressing the C key, press the **SELECT** key to turn the first clock qualifier on.

The clock qualifier consists of two fields: a 48-bit field for internal clock qualification, and a 7-bit field (separated by a "-") for external clock qualification. The 48-bit field corresponds to the data coming into the 16-channel A, B, and C probes and is automatically formatted in accordance with the mixed format specified in Figure 6-4.

Press the HEX, OCT, DEC, BIN and ASC keys to change this field from one format to the other.

Return to the original mixed format by pressing the U key.

EXTERNAL CLK QUAL (NPC-800)

The 7-bit external clock qualifier field corresponds to the header: -AABBCC EL, at the upper right of the CRT. (The eighth bit, L, is not used in the CLOCK QUAL field.) The two A bits correspond to a pair of external qualifier lines (Q_1 and Q_2) coming in through pins 33 and 20 in the A probe; likewise, the two B bits and C bits correspond to qualifier lines on the B and C probes. The E bit corresponds to an additional external qualifier line coming in through the EXTERNAL INPUT BNC connector at the rear of the analyzer.

INTERNAL CLK QUAL

The internal clock qualifier field is used to limit the collection of data to a certain range of address or data words. Without this qualifier, the NPC-800 would simply collect sequential counter data from the test card. Starting with the trigger word **0040,** a nonqualified data collection would consist of **0041, 0042,... 0050, 0051, 0052...**etc. But suppose you wished to exclude from the collection all address words that did not begin with **004.** In other words, the data collection is to contain address words between **0040** and **004F** only. To test this, set the clock qualifier word corresponding to A probe input data to **004X.** (The rest of this field should remain all **X's.**) See Figure 6-7.

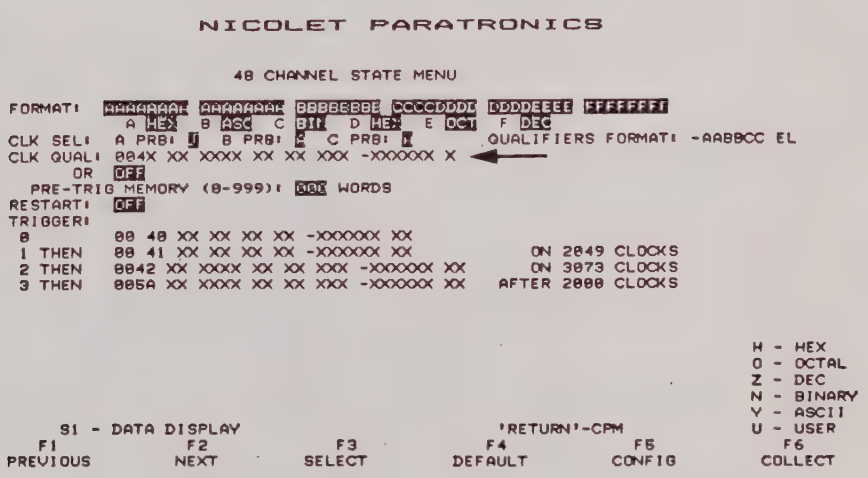

NICOLET PARATRONICS
48 CHANNEL STATE MENU
FORMAT: AAAAAAAA AAAAAAAA BBBBBBBB CCCCDDDD DDDDEEEE FFFFFFFF
A HEX B ASC C BIT D HEX E OCT F DEC
CLK SEL: A PRB: 1 B PRB: 2 C PRB: 3 QUALIFIERS FORMAT: -AABBCC EL
CLK QUAL: 004X XX XXXX XX XX XXX -XXXXXX X
OR OFF
PRE-TRIG MEMORY (0-999): 000 WORDS
RESTART: OFF
TRIGGER:
0 00 40 XX XX XX XX -XXXXXX XX
1 THEN 00 41 XX XX XX XX -XXXXXX XX ON 2049 CLOCKS
2 THEN 0042 XX XXXX XX XX XXX -XXXXXX XX ON 3073 CLOCKS
3 THEN 005A XX XXXX XX XX XXX -XXXXXX XX AFTER 2000 CLOCKS
H - HEX
O - OCTAL
Z - DEC
N - BINARY
Y - ASCII
U - USER
S1 - DATA DISPLAY
'RETURN'-CPM
F1 PREVIOUS
F2 NEXT
F3 SELECT
F4 DEFAULT
F5 CONFIG
F6 COLLECT

Figure 6-7. Setting up the internal clock qualifier field.

COLLECT

Press **COLLECT** to collect qualified data. Notice that the COLLECTION STATUS line reads STATE: TRIGGERED and provides a real-time count as the 1000-word state memory fills up. Also notice that word +017 is now **0040,** instead of **0050.** Scroll the data collection upward. Note that only addresses over the range **0040-004F** are in the data collection. See Figure 6-8.

NICOLET PARATRONICS

MAIN		TRIG	004F	0000	OF	17	255
		+001	0040	0000	OF	17	255
LOC:	TRIG	+002	0041	0000	OF	17	255
		+003	0042	0000	OF	17	255
SIG:	BFEF	+004	0043	0000	OF	17	255
	COBB	+005	0044	0000	OF	17	255
	D8D3	+006	0045	0000	OF	17	255
		+007	0046	0000	OF	17	255
		+008	0047	0000	OF	17	255
		+009	0048	0000	OF	17	255
		+010	0049	0000	OF	17	255
		+011	004A	0000	OF	17	255
		+012	004B	0000	OF	17	255
		+013	004C	0000	OF	17	255
		+014	004D	0000	OF	17	255
		+015	004E	0000	OF	17	255
		+016	004F	0000	OF	17	255
		+017	0040	0000	OF	17	255
		+018	0041	0000	OF	17	255
		+019	0042	0000	OF	17	255

Figure 6-8. Example of qualified data collection containing addresses from 0040 through 004F only.

6.5.7 SAVING DATA (S Key)

To illustrate the SAVE mode, press the **LABELS** key in the top row. Perform the **SAVE** function by pressing the **S** key. This action causes the entire data collection, the test codes (SIG), and the menu parameters to be stored in the NPC-800's auxiliary RAM memory. (Notice the flashing SAVED message.) Now press the **M** key **(MEMSEL)** to cause the auxiliary memory to be displayed. Press **M** again to return the main memory to the screen. Both memories should now contain identical signatures.

6.5.8 AUTOCOLLECT

Press **CTRL** and **C** simultaneously to activate an automatically repeating data collection mode. Press any ASCII key to stop.

HOLD≠ MODE (# Key)

The **HOLD≠** mode is used to detect and isolate intermittent faults. Press the **#** key (**SHIFT** and **3**) to activate the HOLD≠ mode. Note the flashing status messages which indicate that the analyzer is automatically collecting 1000 words and comparing main and auxiliary data.

Hold the shorting wire on pad 1 on the right-hand side **(B side)** of the test card. Note that the flashing status message now reads HOLDING, and data are displayed. Remove the shorting wire from pad 1.

6.5.9 COMPARE (M Key)

Press the M key to compare main and auxiliary test codes. Notice that one of the main memory test codes differs from the corresponding auxiliary memory test code. This indicates that somewhere in the new data collection, there are one or more bits that differ between the main and auxiliary memories. Now return to the main memory.

6.5.10 SCROLL

Locate the end of the data collection by pressing the **LOCATE (F3)** key followed by the **E** key. Then locate word **738** by pressing **LOCATE** and typing **738.** (Remember to **SHIFT** to access the + key or use the SPACEBAR to step through the + field.) To examine the remainder of the data, scroll up or down by pressing the **SCRL UP (F2)** or **SCRL DWN (F1)** **NOTE: Spacebar will also cause data to scroll up and backspace will cause data to scroll down.** Finish with the trigger word at the top of the CRT by pressing **LOCATE** and **T.**

HINT: If you press the wrong key and get an error message, you can use the **BACKSPACE** and **SPACEBAR** keys to edit the **LOCATE** field. Alternatively, you can press **S1** to clear the field.

NICOLET PARATRONICS

MAIN		TRIG	00	4F	F0	0F	FF	FF
		+001	00	40	00	00	FF	FF
LOC:	TRIG	+002	00	41	B0	01	FF	FF
		+003	00	42	40	02	FF	FF
SIG:	BFEF	+004	00	43	C0	03	FF	FF
	50EF	+005	00	44	20	04	FF	FF
	D8D3	+006	00	45	A0	05	FF	FF
		+007	00	46	60	06	FF	FF
		+008	00	47	E0	07	FF	FF
		+009	00	48	10	08	FF	FF
		+010	00	49	90	09	FF	FF
		+011	00	4A	50	0A	FF	FF
		+012	00	4B	D0	0B	FF	FF
		+013	00	4C	30	0C	FF	FF
		+014	00	4D	B0	0D	FF	FF
		+015	00	4E	70	0E	FF	FF
		+016	00	4F	F0	0F	FF	FF
		+017	00	40	00	00	FF	FF
		+018	00	41	B0	01	FF	FF
		+019	00	42	40	02	FF	FF

Figure 6-9. State data in HEX format.

6.5.11 DIFFERENCE MODE (/ Key)

The **DIFFERENCE** mode is used for the rapid identification of differences between main memory and previously-saved auxiliary memory data.

Press the / key (under the ? key) to activate the **DIFFERENCE** mode. (This function toggles so that repeated keystrokes turn it on and off.) In this mode, only data words which differ between the main and auxiliary memories are displayed at full-intensity. (Data words that match are displayed at half-intensity.) Press the **SCRL UP (F2)** key to find the first difference word.

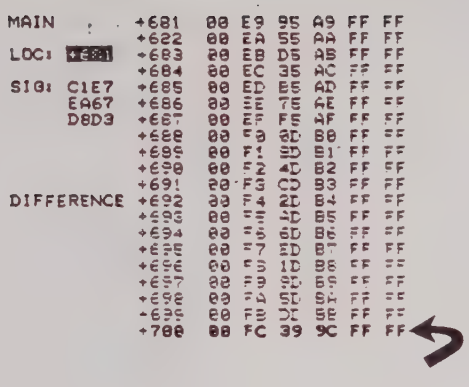

MAIN
LOC: +681
SIG: C1E7
EA67
D8D3
DIFFERENCE
+681 00 E9 95 A9 FF FF
+682 00 EA 55 AA FF FF
+683 00 EB D5 AB FF FF
+684 00 EC 35 AC FF FF
+685 00 ED B5 AD FF FF
+686 00 EE 75 AE FF FF
+687 00 EF F5 AF FF FF
+688 00 F0 2D B0 FF FF
+689 00 F1 ED B1 FF FF
+690 00 F2 4D B2 FF FF
+691 00 F3 CD B3 FF FF
+692 00 F4 2D B4 FF FF
+693 00 F5 AD B5 FF FF
+694 00 F6 6D B6 FF FF
+695 00 F7 ED B7 FF FF
+696 00 F8 1D B8 FF FF
+697 00 F9 9D B9 FF FF
+698 00 FA 5D BA FF FF
+699 00 FB DD BB FF FF
+700 00 FC 39 9C FF FF

Figure 6-10. In this example, the first difference word occurs at +700. (Your example will probably be different.)

Press the N key to view the difference data in binary. Then press and hold the M key to locate the specific bits responsible for the differences.

6.5.12 LOCATE DIFFERENCE (LOCATE + D)

Return to the main memory and press the H key. Press **LOCATE (F3)** followed by D to place the first difference word at the top of the screen. (This is an alternative and faster way of locating the first difference word.) Now press **LOCATE** followed by S to find the next group of half-intensified words that are the "same" (if any). Press the **SCRL DWN (F1)** key once to verify this. See Figure 6-11.

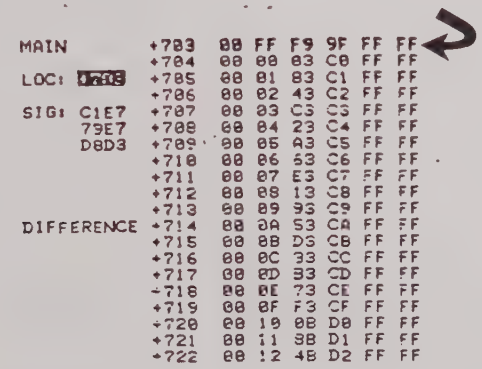


Figure 6-11. In this particular example, word +704 is the first word in the next group of data words that are the "same." (Your example will probably turn out differently.)

Press **LOCATE** followed by T to place the trigger word at the top of the CRT. Then press the / key to disable the difference mode.

6.5.13 PRETRIGGER

Use the NEXT key to access the pretrigger field. Enter 0-0-3 into this field. See Figure 6-12.

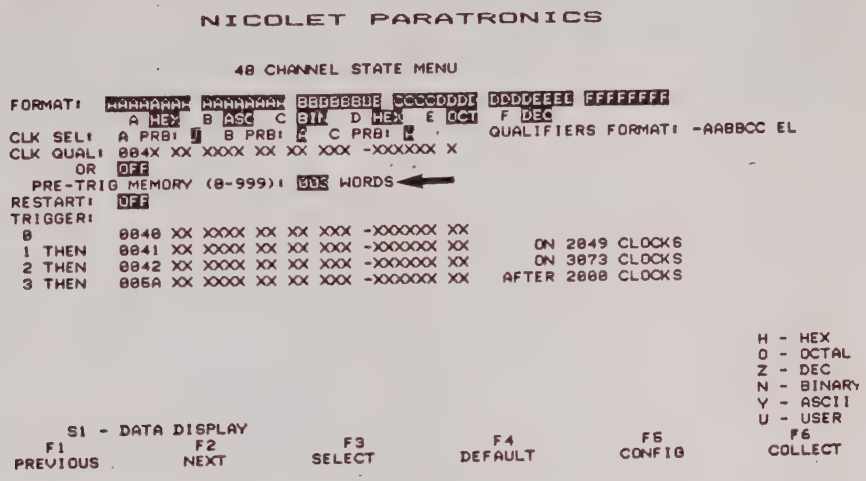

NICOLET PARATRONICS
48 CHANNEL STATE MENU
FORMAT: AAAAAAAA BBBBBBBB CCCCDDDD DDDDEEEE FFFFFFFF
A HEX B ASC C BIN D HEX E OCT F DEC
CLK SEL: A PRB: 0 B PRB: 2 C PRB: 4
QUALIFIERS FORMAT: -AABBCC EL
CLK QUAL: 004X XX XXXX XX XX XXX -XXXXXX X
OR OFF
PRE-TRIG MEMORY (0-999): 003 WORDS
RESTART: OFF
TRIGGER:
0 0040 XX XXXX XX XX XXX -XXXXXX XX
1 THEN 0041 XX XXXX XX XX XXX -XXXXXX XX ON 2049 CLOCKS
2 THEN 0042 XX XXXX XX XX XXX -XXXXXX XX ON 3073 CLOCKS
3 THEN 005A XX XXXX XX XX XXX -XXXXXX XX AFTER 2000 CLOCKS
H - HEX
O - OCTAL
Z - DEC
N - BINARY
Y - ASCII
U - USER
S1 - DATA DISPLAY
F1 PREVIOUS
F2 NEXT
F3 SELECT
F4 DEFAULT
F5 CONFIG
F6 COLLECT

Figure 6-12. State menu set for pretrigger data collection.

COLLECT

In order to view pretrigger data, press COLLECT. Then press the LOCATE and B keys. This will cause the first (or beginning) word in the data collection (-003) to be displayed at the top of the display. See Figure 6-13.

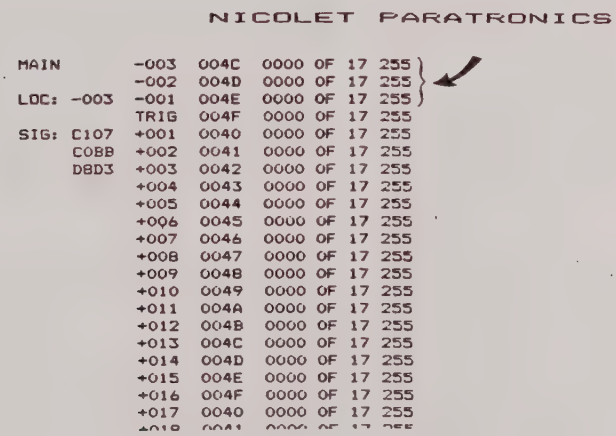


Figure 6-13. Example of pretrigger data.

PRETRIGGER MECHANISM

The maximum pretrigger value is 999*. For the NPC-800, this means that as many as 999 words prior to the trigger word can be collected. However, it should be noted that the NPC-800's pretriggering mechanism is specifically designed so that any given pretrigger value reflects the maximum number of data words that can be collected prior to the trigger. This means, for example, if a pretrigger value of 10 was used, the amount of data words collected prior to the trigger could be anywhere between 1 and 10. This type of pretrigger mechanism is employed so that the user doesn't have to be absolutely certain when he presses **COLLECT** that at least 10 events are going to occur prior to the trigger. If fewer events occur, the data collection will still be accomplished and the results displayed. (Other approaches cause the data collection to be inhibited if an internal pretrigger counter is not allowed to count down to zero.) Experiment with the NPC-800's pretrigger mechanism by setting in the maximum pretrigger value. Then press **COLLECT** followed by **LOCATE** and **B**. Repeat this several times and note that the beginning word in the data collection will vary, depending on where the trigger word happens to be in the test card's 256-step count loop when you press **COLLECT**.

Press **P** to return to the PRETRIGGER field and set this field to 000 (no pretrigger data). Press **COLLECT**. Then press the **LOCATE** and **T** keys to return the trigger word to the top of the display.

6.5.14 SEARCH WORD

The SEARCH WORD mode allows you to locate any particular bit pattern within a data collection; you specify the word to search for and then the direction of search.

Press the **SRCH WRD (F4)** key to obtain the menu shown in Figure 6-14.

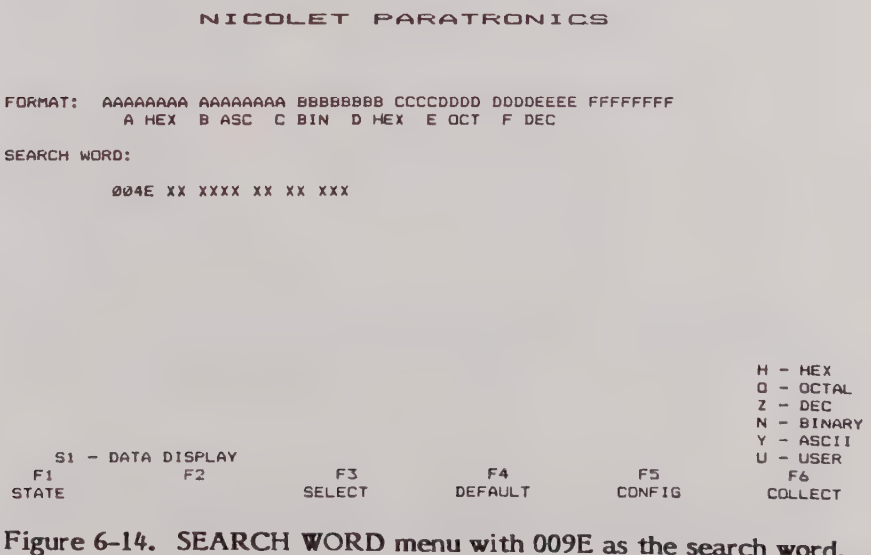


Figure 6-14. SEARCH WORD menu with 009E as the search word.

K, J

In the example, 004E is used as the word to be found in the data collection. Type in 0-0-4-E (the rest of the field are X's--DON'T CARE.) Press S1 to display the data again, then press K to search the data for 004E. See Figure 6-15. Press K again to search for additional occurrences of 004E further down in the memory. Press J to search in the opposite direction.

NICOLET PARATRONICS

MAIN		+015	004E	0000	OF	17	255 ←
		+016	004F	0000	OF	17	255
LOC:	+015	+017	0040	0000	OF	17	255
		+018	0041	0000	OF	17	255
SIG:	C107	+019	0042	0000	OF	17	255
	C0B8	+020	0043	0000	OF	17	255
	D8D3	+021	0044	0000	OF	17	255
		+022	0045	0000	OF	17	255
		+023	0046	0000	OF	17	255
		+024	0047	0000	OF	17	255
		+025	0048	0000	OF	17	255
		+026	0049	0000	OF	17	255
		+027	004A	0000	OF	17	255
		+028	004B	0000	OF	17	255
		+029	004C	0000	OF	17	255
		+030	004D	0000	OF	17	255
		+031	004E	0000	OF	17	255
		+032	004F	0000	OF	17	255
		+033	0040	0000	OF	17	255
		+034	0041	0000	OF	17	255

Figure 6-15. Data collection showing 004E at the top of the display after the data search is completed.

NOTE: This is a good stopping point if you wish to power down.

6.5.15 RESTART

When tracing program flow, there can be several paths leading to the same point in the program. The restart feature of the NPC-800 gives you control over which path will be actually traced by the analyzer to get to the desired trigger point. Figure 6-16 illustrates this concept.

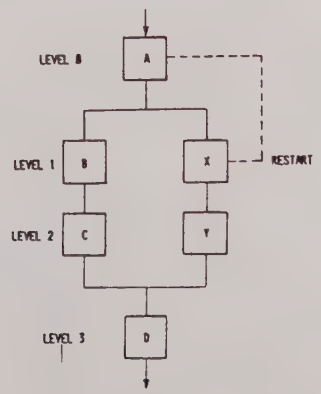


Figure 6-16. Using the RESTART feature to ensure that program path A-B-C-D is followed.

RESTART EXAMPLE

Suppose that to get to point D, the program in Figure 6-16 can follow either path A-B-C-D or path A-X-Y-D. If the trigger stack is set up to trace path A-B-C-D but path A-X-Y-D occurs, the analyzer will be "hung-up" at level 1 because event B never occurred. The restart feature is used to reset the stack back to level 0 whenever an event in the undesired path occurs. Thus, if RESTART = X, the occurrence of the undesired path (A-X-Y-D) will be detected and the trigger stack will automatically restart at level 0 as if a **COLLECT** had occurred. Then, when path A-B-C-D occurs, the analyzer will be ready and the triggering sequence will go to completion.

Access the RESTART field by pressing the T and **PREVIOUS** keys. Then press the **SELECT** key. (Notice that the RESTART word has the same mixed format as the clock qualifiers and trigger words.) Enter the value **0080** for the RESTART word. See Figure 6-17.

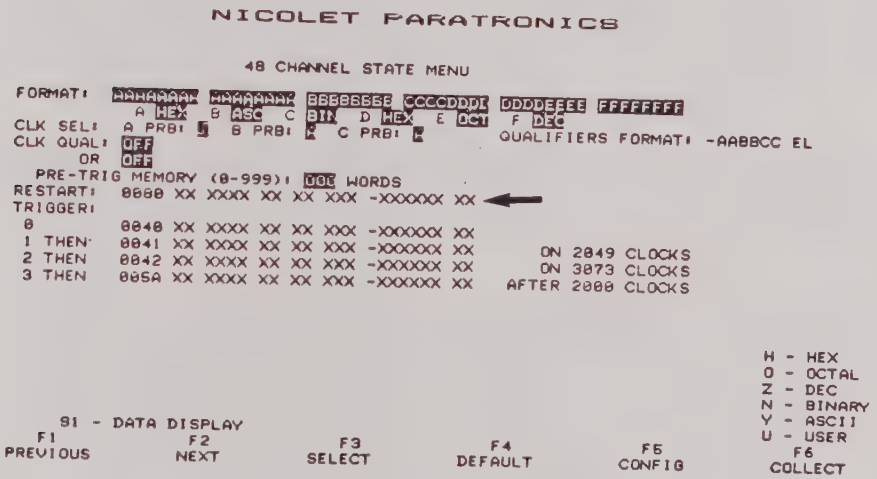

NICOLET PARATRONICS
48 CHANNEL STATE MENU
FORMAT: AAAAAAAA BBBBBBBB CCCCDDDD DDDDEEEE FFFFFFFF
A HEX B ASC C BIN D HEX E OCT F DEC
CLK SEL: A PRB: 7 B PRB: C PRB:
QUALIFIERS FORMAT: -AABBCC EL
CLK QUAL: OFF
OR OFF
PRE-TRIG MEMORY (0-999): 000 WORDS
RESTART: 0080 XX XXXX XX XX XXX -XXXXXX XX
TRIGGER:
0 0040 XX XXXX XX XX XXX -XXXXXX XX
1 THEN 0041 XX XXXX XX XX XXX -XXXXXX XX ON 2049 CLOCKS
2 THEN 0042 XX XXXX XX XX XXX -XXXXXX XX ON 3073 CLOCKS
3 THEN 00SA XX XXXX XX XX XXX -XXXXXX XX AFTER 2000 CLOCKS
H - HEX
O - OCTAL
Z - DEC
N - BINARY
Y - ASCII
U - USER
SI - DATA DISPLAY
F1 PREVIOUS
F2 NEXT
F3 SELECT
F4 DEFAULT
F5 CONFIG
F6 COLLECT

Figure 6-17. State menu with RESTART word 0080.

COLLECT

In order to test the restart feature, we'll create an "apparent" branch in the test card's counter sequence. To do this, short out pad 7 (MSB) on the A side of the test counter. This causes the counter output sequence to consist of 128 counts (0000-007F) instead of 256 counts (0000-00FF). With pad 7 shorted, press **COLLECT**. Since the RESTART word 0080 never occurs, the trigger sequence goes to completion. Now press **COLLECT** again and remove the short **before** level 3 is reached. Note that the stack returns to level 0 (flashing) because the RESTART word **0080** is now permitted to occur. See Figure 6-18. Again short out pad 7 and watch the trigger sequence go to completion. Remove the short.

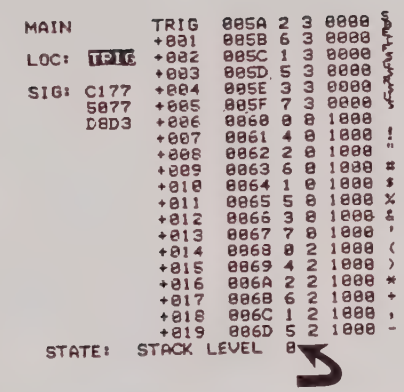


Figure 6-18. The occurrence of 0080 (RESTART) causes the trigger stack to reset to level 0.

RESTART

Return to the RESTART field and press the **SELECT** key to activate the RESTART mode. Like the RESTART word which forces the stack back to level 0, the occurrence of any data pattern not matching the RESTART word forces the stack back to level 0. Press the **SELECT** key to turn RESTART off.

6.5.16 TRIGGER QUALIFIERS

Notice that each trigger level or RESTART word can also be set up to require the occurrence of the external trigger qualifier events: -AABBCC EL. The AABBCC and E signals are physically the same external input probe lines that were previously discussed in connection with the clock qualifier fields. However, in this case, they act as enabling signals to the incoming trigger words. Thus, if level 1 were set up as follows:

0041 X X XXXX XX -1XXXXX 1X,

then the A probe qualifier on pin 33 must be high (1) and the external BNC input on the rear panel must also be high (1) when 0041 occurs; otherwise, the analyzer will not advance to level 1 from level 0. (Do not actually change the trigger qualifier from all X's.)

The L bit is another trigger qualifier which links any stack level to the successful triggering of the timing or waveform analyzers or another analyzer connected to the LINK BNC on the back panel. (The use of the L bit is discussed in more detail later.) In microprocessor applications, for example, trigger qualifiers can control triggering using signals that are generally not on the address bus or data bus, or are not required in the data collection. As such, they can be considered as extra channels that are not displayed. Thus, for the NPC-800, a 56-bit-wide trigger word can be specified (48 data channels plus 8 trigger qualifiers).

6.5.17 NONOCCURRENCE TRIGGERING

Press the **NEXT** key and step to trigger level 1. Then use the **SELECT** key to choose the nonoccurrence triggering mode. The trigger word for level 1 will now be displayed as:

0041 X X XXXX XX -XXXXXX XX.

This mode can be used to trace program sequences when expected events are not occurring. In this example, the analyzer would pass through level 1 only if **0041 did not occur** precisely **2049** clocks after **0040.** Nonoccurrence triggering is available at each of the 16 levels. Note that the qualifiers do not change sense in the nonoccurrence triggering mode.

6.6.0 TIMING ANALYSIS EXAMPLES

The timing analyzer is separate from the state analyzer that has just been reviewed. It records data in a separate memory and uses its own menu for setup. The following section reviews its functions and how to use them.

6.6.1 SET UP

Before starting this test, connect the two A and B Model 81 Timing Probes to the NPC-800. Then connect these probes to the Test Card's A and B outputs, respectively. (You can leave the state probes plugged into the NPC-800.)

6.6.2 TIMING MENU

Press F5 to return to the configuration list. Press F4 (select down) to move down to 16 channel timing. Figure 6-19 shows the resulting data collection when F1 is pressed.

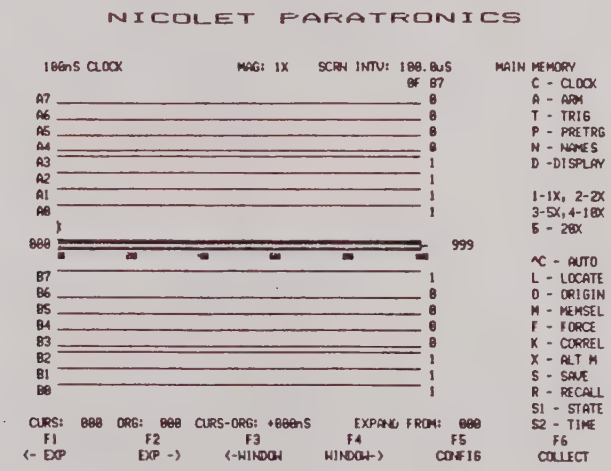


Figure 6-19. Timing data collection using default values on the menu.

6.3 COLLECTION

Leave all menu parameters set at their default values as shown in Figure 6-20. Press the **COLLECT (F6)** key. Notice a brief status message TRIGGERED appearing in the lower left corner of the CRT screen. When a timing data collection is complete, the message "DONE" is displayed briefly in its place, and the screen fills with the timing diagram display.

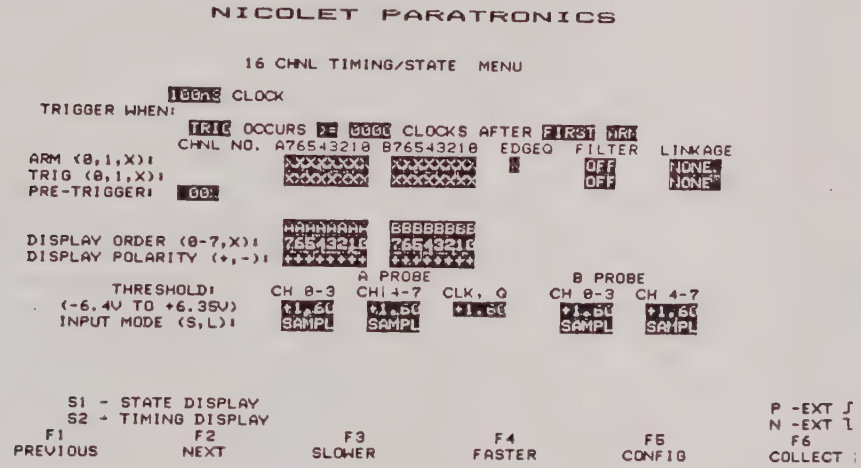


Figure 6-20. Timing Menus - Default Values

6.4 ASCII KEY FUNCTIONS (LABELS)

Press the **LABELS** key to call the DISPLAY menu. See Figure 6-21.

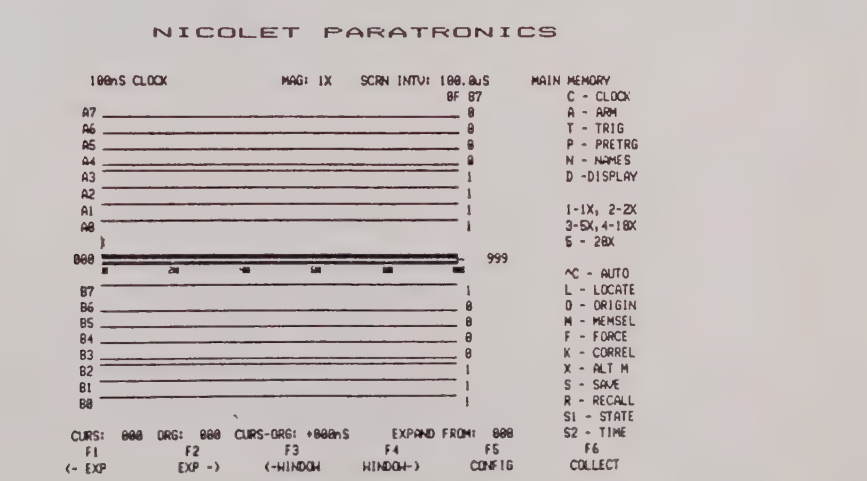
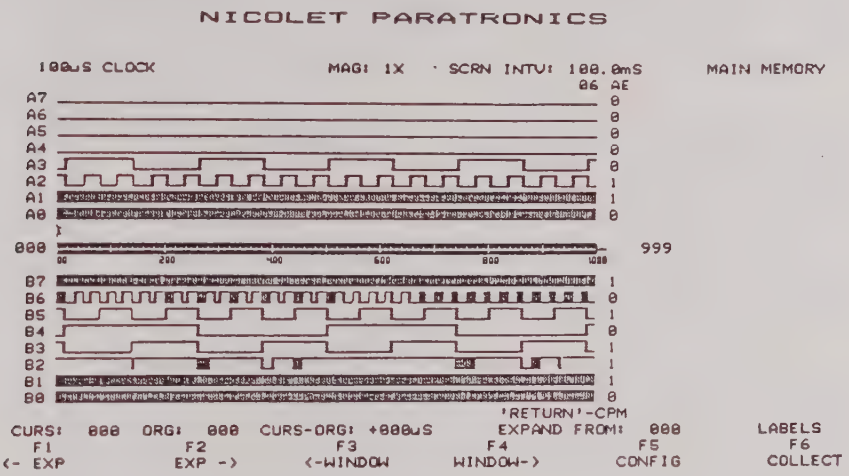


Figure 6-21. Showing the LABELS function on the Timing Diagram.

6.6.5 CLOCK

The menu shows the sampling rate (clocking speed) in the top right hand corner. The default value of 100nS is very fast for the CMOS circuit on the test card and hence little activity is seen on the timing diagram. See Figure 6-19. To return to the menu and enter the clock field press **C**. Use the **F3** key (slower) to set the sampling rate to 100 microseconds. Press **F6** (COLLECT) to collect data. The resulting collection is shown in Figure 6-22.
Notice: (1) The high and low transitions shown on most lines and (2) The cross hatching on lines A1 and A2. This will be discussed later in "Magnification."



6.6.6 TRIGGER

To enter a trigger word, return to the trigger field in the menu by pressing **T.** ENTER **00001100** XXXXXXXX
Press F6 to collect data.

6.6.7 DISPLAY

The horizontal inverse video graticule at the middle of the display in Figure 6-22 represents the entire 1000 samples in the memory. Note that the small 00 indicator at the left end of the graticule is intensified, indicating the 00% pretrigger value set in previously. With 00% pretrigger, the first word in the data collection always is the trigger word.

6.6.8 MAGNIFICATION

Try magnification factors between 2X to 20X using the **2** to **5** numeric keys as indicated in the DISPLAY MENU. After each higher magnification key is pressed, the inverse video indicator at the bottom of the screen reduces proportionately in size. This indicator shows the location and amount of timing data currently being displayed relative to the entire 1000-word data collection. At 20X magnification, note that the inverse video indicator is only 5% of its original (1X) size and that the screen is now displaying timing data between memory locations **000** and **099.** See Figure 6-22.

6.6.9 WINDOW

View other segments of the memory by pressing the **-WINDOW (F3)** or the **WINDOW- (F4)** keys. Return to a data window of 500 to 549 as shown in Figure 6-23. Also return the expansion symbol to the left-hand side of the CRT.

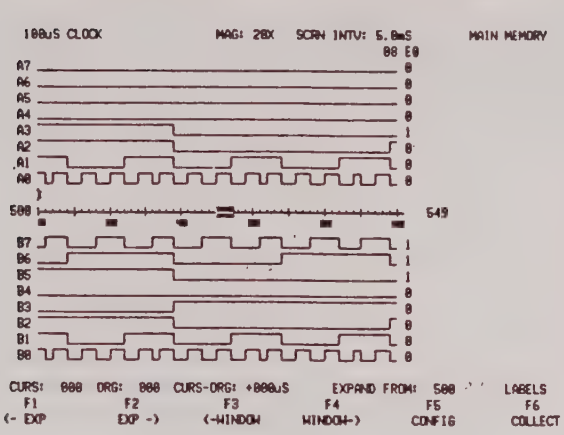


Figure 6-23. Magnified data display X20. Locations 500 to 549.

6.6.10 CURSOR

To quickly set the cursor (which is currently at 000) to the left side of the screen, simply press the **L (LOCATE CURSOR)** key as indicated in the **LABELS** menu. Bring the cursor to the approximate center of the CRT by pressing the **SPACE BAR** key. (Overshooting can be remedied by pressing the **BACKSPACE** key.)

6.6.11 TIME MEASUREMENTS (O)

In this step, you will measure the relative time between the edges in two channels. Visually select an edge (rising or falling) in channel A2 and another edge (later in time) in channel B6. Step the cursor so that it aligns with the selected edge in channel A2. Note the value of the cursor position indicator at the lower left of the screen. Now press the letter **O** to reset the **origin** from 000 to the current cursor location. The CURS-ORG indicator should now read in units of time. (When an external clock is being used, the indicator reads **+0CS**, where CS stands for clock samples. Next, step the cursor to the selected edge on channel B6. The CURS-ORG indicator will now directly read the time (in clock samples) between these two edges. Figure 6-24 shows one example of using this measurement procedure.

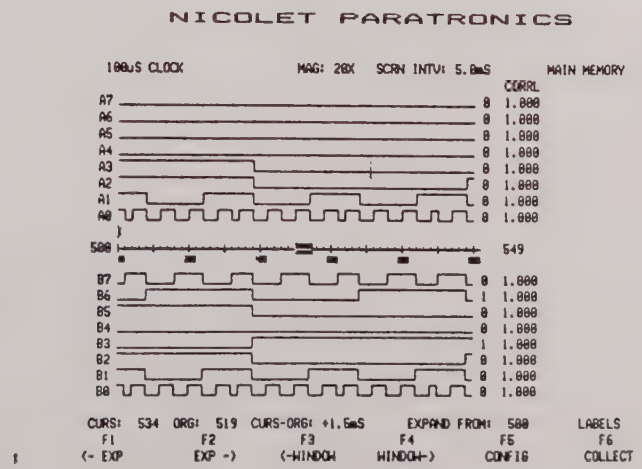


Figure 6-24. One example of measuring the relationship between timing data edges. (Your example may differ.)

6.6.12 STATE DATA FROM THE TIMING DIAGRAM

The cursor reads the binary and hexadecimal values of each location in the data memory where the cursor is placed. Thus, the trigger word at cursor location 000 should be $(0F87)_{HEX}$. In Figure 6-21, this trigger word appears at the upper right-hand-corner of the CRT.

Figure 6-22 also shows the sixteen timing channels and the corresponding binary values at cursor location 000. Note that the four most significant A channels (A7-A4) are at ground as described in Section 6.1. Also note that the cross-hatched areas on certain channels indicate that data in the memory are occurring too close together at the current X1 magnification factor to be resolved **visually.** (However, cursor values at the right of the CRT are always valid at **all** magnification factors.)

6.6.13 CORRELATION (K)

Press the **SAVE (S)** key and observe the flashing SAVED message. Press the **K (CORREL)** key to compare main and auxiliary data. Note that a correlation factor of 1.000 is displayed at the right of each channel. This factor means that all 1000 bits associated with each main memory channel compares with the 1000 bits in the corresponding auxiliary memory channel on a bit-for-bit basis. See Figure 6-25. Thus, if a correlation factor of .995 were displayed, it would indicate that 5 bits out of 1000 were different.

Note that when the **K** key is pressed, the correlation factors replace the NAMES. See section 6.6.14. To restore the NAMES, press S2.

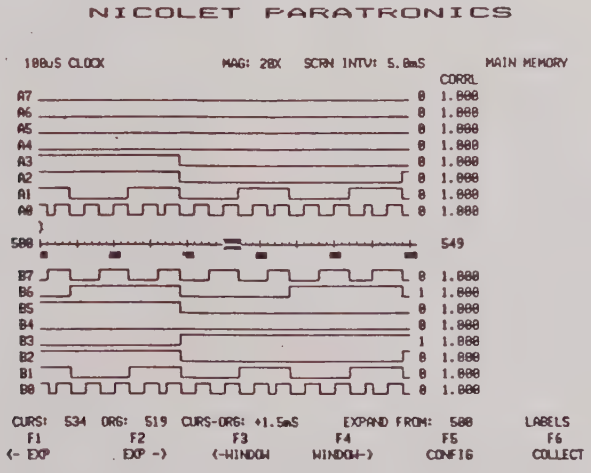


Figure 6-25. A correlation factor of 1.000 means that data in a main memory channel precisely matches the data in the corresponding auxiliary memory channel.

Now short out the pad labeled 5 on the B side of the demo card. While holding the short in place, press COLLECT. Now remove the short. To see which channel was affected by the short, again press K. Note that the correlation factor for channel B5 is significantly lower than 1.000, as are many of the other channels.

MAIN/AUX MEMORY COMPARE (X)

In order to view the actual effect of the short on channel B5, press the X (ALT MEMORY) key. As shown in Figure 6-26, channel B5 should cycle between a 1 and a 0. Return to a X1 magnification by pressing the 1 key. (The main memory should be displayed.)

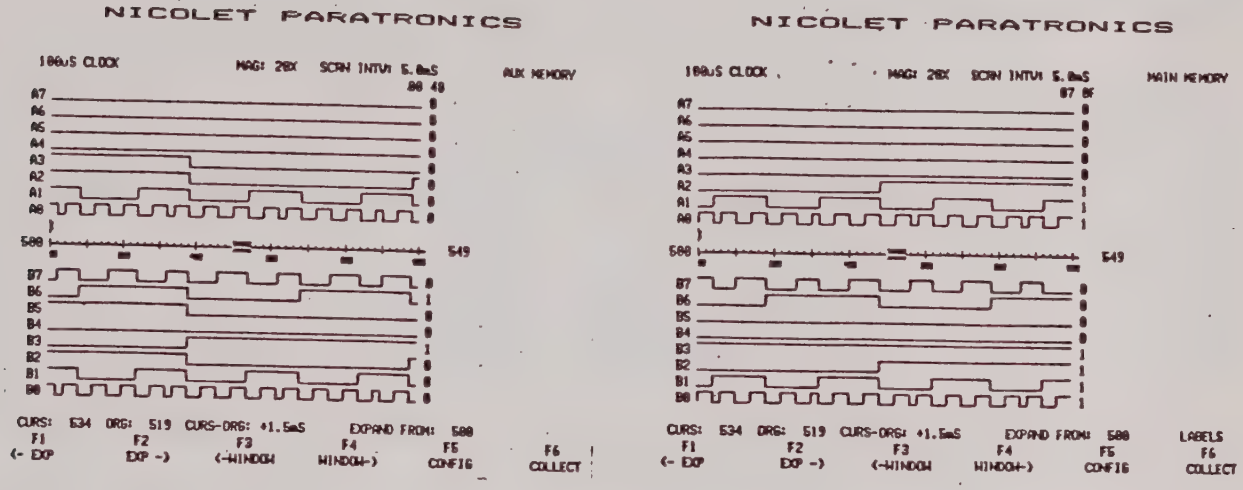


Figure 6-26 A & B.

Using the MEMORY SELECT key to observe the effect of the short in channel B5. (A) Shows the auxiliary memory. (B) Shows the main memory. Alternate between the two by pressing X key.

6.6.14 NAMES

Press the N key to activate the NAME cursor at the upper right-hand side of the screen. Each channel can have up to 8 characters for a name. Enter characters from the ASCII keyboard, terminate each line with a CR and when all the required labels have been assigned press the ESC key. To edit labels, use the SPACEBAR and BACKSPACE to move the cursor and type in new entries as required. See Figure 6-27.

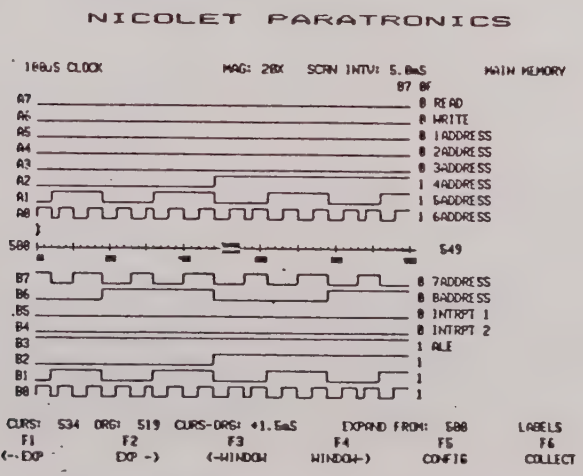


Figure 6-27. The assignment of labels (NAMES) to the timing diagram.

6.6.15 TIMING DISPLAY MANIPULATION

Access the DISPLAY ORDER field by pressing the D key. To illustrate the timing display flexibility of the NPC-800, set in the following display order for the 8 most significant channels: B4 - A0 - A6 - B7 - B0 - X - B4 - A2. Use the **NEXT** key to step down to the DISPLAY POLARITY field. Then set in the following display polarity: **-+++-+++**, (Remember to use keys **F3** and **F4** to make entries in this field. See Figure 6-28.

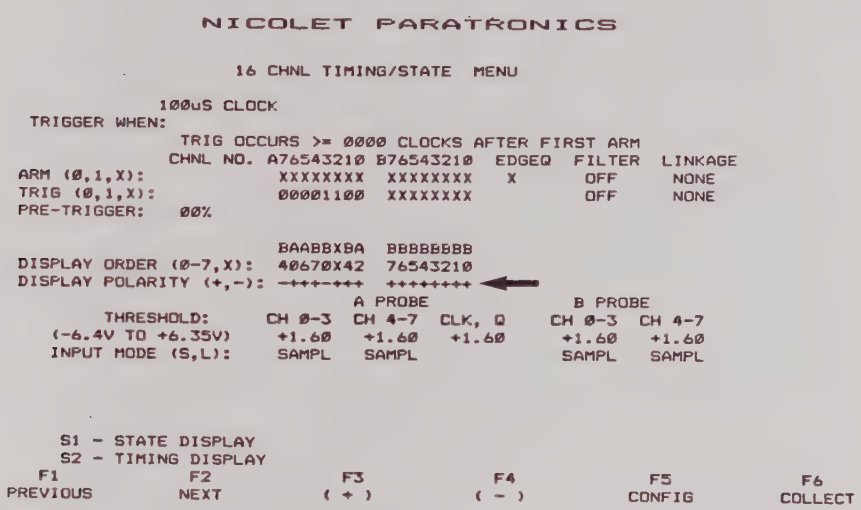

NICOLET PARATRONICS
16 CHNL TIMING/STATE MENU
100uS CLOCK
TRIGGER WHEN:
TRIG OCCURS >= 0000 CLOCKS AFTER FIRST ARM
CHNL NO. A76543210 B76543210 EDGEQ FILTER LINKAGE
ARM (0,1,X): XXXXXXXX XXXXXXXX X OFF NONE
TRIG (0,1,X): 00001100 XXXXXXXX OFF NONE
PRE-TRIGGER: 00%
BAABBXBA BBBBBBBB
DISPLAY ORDER (0-7,X): 40670X42 76543210
DISPLAY POLARITY (+,-): -+++-+++ ++++++++
A PROBE B PROBE
THRESHOLD: CH 0-3 CH 4-7 CLK, Q CH 0-3 CH 4-7
(-6.4V TO +6.35V) +1.60 +1.60 +1.60 +1.60 +1.60
INPUT MODE (S,L): SAMPL SAMPL SAMPL SAMPL
S1 - STATE DISPLAY
S2 - TIMING DISPLAY
F1 PREVIOUS
F2 NEXT
F3 (+)
F4 (-)
F5 CONFIG
F6 COLLECT

Figure 6-28. The menu used to illustrate the NPC-800's timing display flexibility.

S2
4 (10X)

Now press the S2 and **4** (10X) keys. At 10X magnification, the timing diagram will be similar to Figure 6-29. Note that the NPC-800 permits any mix of inverted and noninverted channels to be displayed. Also note that any channel can be blanked out and any channel can be repeated. In Figure 6-29, B4 is inverted at the top of the CRT and is adjacent to A0. Near the center of the display, B4 appears non-inverted and is adjacent to A2.

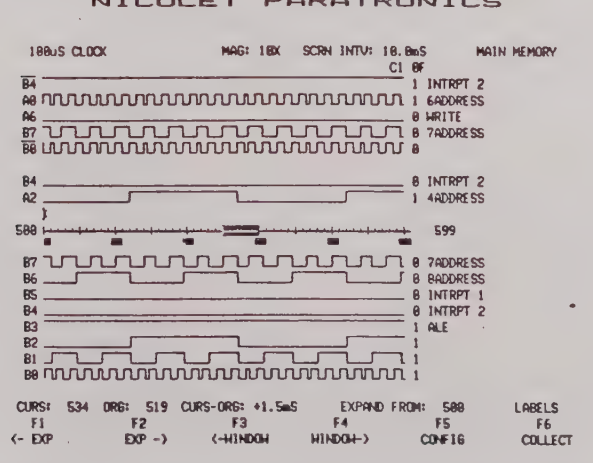


Figure 6-29. Demonstrating the NPC-800's timing diagram display flexibility.

6.6.16 THRESHOLD

In the 16 CHANNEL TIMING mode, the threshold level for the 16 inputs to the Model 81 probes is keyboard settable in 50 mV increments between -6.40V and +6.35V, in 4 bit groups. The clock and qualifier inputs, CLK and Q, are adjustable independently of channels 4-7. These features are useful for monitoring ECL logic and mixed logic families. When the cursor is located in one of the Threshold selection fields, a voltage value within the specified range may be entered, or **T** will automatically select +1.6 for TTL, **E** will select -0.3 for ECL.

6.6.17 EXTERNAL

The examples so far have used an internal clock for sampling data, however, the user can specify an external clock for all 16 channels. Figure 6-29 shows the menu with an external clock selected. Press the **C** key to get into the clock field in the timing menu. Using key **F3** or **F4** select an external clock with a rising or falling edge. Note one bit is available for clock qualification. This can be utilized by connecting the qualifying channel to line 33 on the ? probe and setting 1 or 0 in the menu field. Press the COLLECT key and note the changes to the timing diagram. (1) The clock specification is now external clock. (2) The time difference is now measured in clock cycles(os). See Figure 6-30.

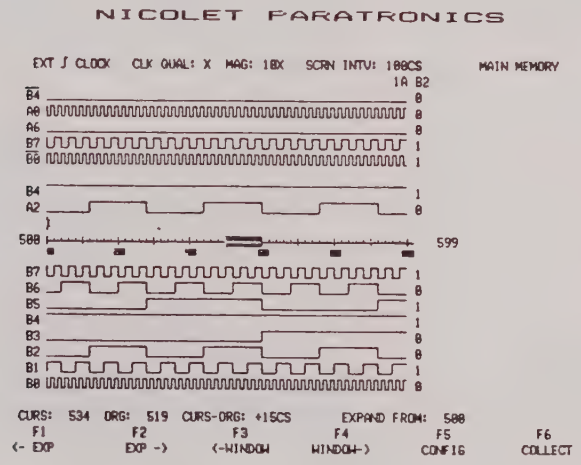


Figure 6-30. Timing diagram using an external clock.

6.6.18 ARM AND TRIG

With the 16-CHANNEL TIMING/STATE menu on the display and the cursor at the CLOCK field, select the **2 mS** clock by using the **SLOWER** key.

In this example, both levels of triggering will be used. Press **S2** and **A** as a quick way to enter the ARM field. Then enter: **0-0-0-0-0-0-0-0** plus **0-1-0-0-1-0-0-0**, which is **(0048)**$_{HEX}$. Use the **NEXT** key to step down to the TRIG field and enter: **0-0-0-0-0-0-0-0** plus **1-1-0-0-1-0-0-0**, which is **(00C8)**$_{HEX}$.

6.19 TRIGGERING MODES

Because we have now set up two levels of triggering (ARM and TRIG), we must use one of the triggering modes to specify the time delay between these levels. Use the **PREVIOUS** key to access the TRIGGER MODE field. Press the **SELECT** key to view the following major timing trigger mode options:

TRIG OCCURS 0001 CLOCKS AFTER FIRST ARM

TRIG OCCURS BEFORE 0001 ARMS

Note that within the first two major trigger modes, the **NEXT** and **SELECT** keys can be used to change TRIG to TRIG, to or = (blank), BEFORE to AFTER, FIRST to LAST, and ARM to ARM.

Set the trigger mode to TRIG OCCURS 0000 CLOCKS AFTER FIRST ARM. Then use the **NEXT** key to step to the DELAY field and set in a delay value of 1501. The trigger mode should now read:

TRIG OCCURS 1501 CLOCKS AFTER FIRST ARM.

6.6.20 PRETRIGGER

Access the PRETRIGGER field by pressing the S2 and P keys. Use "soft" key **DECR** to set this field for 50% pretrigger. Figure 6-31 shows the timing menu up to this point.

```
                    NICOLET PARATRONICS

                  16 CHNL TIMING/STATE  MENU

                2mS CLOCK
 TRIGGER WHEN:
                TRIG OCCURS >= 1501 CLOCKS AFTER FIRST ARM
                CHNL NO. A76543210 B76543210  EDGEQ  FILTER  LINKAGE
ARM (0,1,X):             00000000  01001000    X      OFF     NONE
TRIG (0,1,X):            00000000  11001000           OFF     NONE
PRE-TRIGGER:   50%

                         BAABBXBA  BBBBBBBB
DISPLAY ORDER (0-7,X):   40670X42  76543210
DISPLAY POLARITY (+,-):  -+++-+++  ++++++++
                              A PROBE              B PROBE
       THRESHOLD:        CH 0-3  CH 4-7  CLK, Q   CH 0-3  CH 4-7
  (-6.4V TO +6.35V)       +1.60   +1.60   +1.60     +1.60   +1.60
  INPUT MODE (S,L):       SAMPL   SAMPL            SAMPL   SAMPL


   S1 - STATE DISPLAY
   S2 - TIMING DISPLAY
  F1        F2          F3          F4          F5          F6
PREVIOUS    NEXT        INCR        DECR        CONFIG      COLLECT
```

Figure 6-31. Menu corresponding to this example thus far.

STATUS MESSAGES

Press **COLLECT** and wait several seconds. Notice the flashing status messages which indicate what the analyzer is doing as it transitions from SAMPLING to ARMED to TRIGGERED to DONE. (The relatively slow 2 mS clock allows these messages to be observed.)

LOCATING THE TRIGGER WORD

With the timing diagram displayed (at 1X magnification), the next step is to locate the trigger word, **00000000 11001000 (00C8)**. Notice that the 500 mark on the inverse video graticule at the bottom of the CRT is at full-intensity. This is the location of the trigger word with 50% pretrigger set in. When the **COLLECT** key was pressed, the following sequence of events occurred:

1. SAMPLE (COLLECT DATA AT 2 mS INTERVALS)
2. DETECT ARM WORD (0048)
3. COUNT AT LEAST 1501 CLOCKS (3 seconds +)
4. COLLECT PRETRIGGER DATA (500 WORDS PRIOR TO TRIGGER WORD)
5. DETECT TRIG WORD (00C8)
6. COLLECT TRIGGER WORD AND FILL REMAINING MEMORY (TRIGGER WORD PLUS 499 ADDITIONAL WORDS)
7. DISPLAY (MESSAGE DONE)

The display at 1X magnification is shown in Figure 6-32.

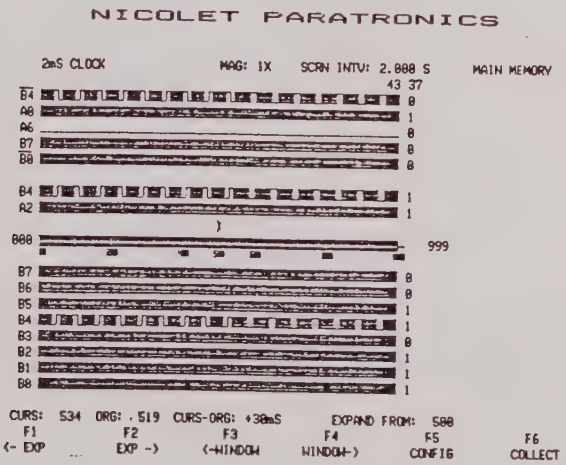


Figure 6-32. Timing display at 1X magnification.

6.21 FILTER

Access the ARM field by pressing the A key. Then step to the FILTER field associated with the ARM word using the **NEXT** key. The filter fields are used to make certain that the associated ARM or TRIG words are stable for 2 to 16 clock sample periods before they are considered valid. This feature avoids the generation of false ARM or TRIG words due to race conditions, propagation delays, or other transient events on the bus. (Note: the FILTER field ignores data entry values of 0 or 1.)

6.6.22 LINKING STATE TO TIMING

To demonstrate the use of both analyzers, reconnect the probes as follows: **Connect the A state probe to the A side of the test card and the A timing probe to the B side of the test card.** Change the timing analyzer ARM and TRIGGER words as shown in Figure 6-33.

Press the **F5** key to call back the Configuration List and select the 48 CHANNEL STATE/16 CHANNEL TIMING mode (Configuration #3). Call the timing menu (**F2** key) and access the linkage field in the ARM word. Use the **SELECT** key to set this field to **L.** See Figure 6-33. The ARM word is now linked to the successful triggering of the state section.

```
                    NICOLET PARATRONICS

                  16 CHNL TIMING/STATE  MENU

                  2mS CLOCK
 TRIGGER WHEN:
                  TRIG OCCURS >= 1501 CLOCKS AFTER FIRST ARM
                 CHNL NO. A76543210 B76543210  EDGEQ  FILTER  LINKAGE
 ARM (0,1,X):              00000000  XXXXXXXX    X      OFF      L
 TRIG (0,1,X):             00000000  XXXXXXXX           OFF      NONE
 PRE-TRIGGER:   50%

                           BAABBXBA  BBBBBBBB
 DISPLAY ORDER (0-7,X):    40670X42  76543210
 DISPLAY POLARITY (+,-): -+++-+++  ++++++++
                                 A PROBE              B PROBE
        THRESHOLD:        CH 0-3  CH 4-7  CLK, Q   CH 0-3  CH 4-7
   (-6.4V TO +6.35V)       +1.60   +1.60   +1.60     +1.60   +1.60
    INPUT MODE (S,L):      SAMPL   SAMPL            SAMPL   SAMPL



    S1 - STATE DISPLAY
    S2 - TIMING DISPLAY
  F1          F2          F3          F4          F5          F6
PREVIOUS      NEXT                                CONFIG      COLLECT
```

FIGURE 6-33. Timing menu with the linkage bit set in the ARM linkage field.

COLLECT

Press the **COLLECT** key and watch the status messages go through the following sequence:

STATE:	STACK LEVEL 0	**TIMING:**	SAMPLING
	STACK LEVEL 1		SAMPLING
	STACK LEVEL 2		SAMPLING
	STACK LEVEL 3		SAMPLING
	TRIGGERED ----------		ARMED
	DONE (LINKAGE)		TRIGGERED
			DONE

LINKAGE

Notice how the timing analyzer continues sampling until the state section passes through stack level 3. At that instant, the timing analyzer's ARM word is enabled by the linkage bit so that when the ARM word actually occurs, the timing analyzer will be armed. (Meanwhile, the state analyzer is collecting data.) Then, after the 1501 clock delay is counted down, the timing analyzer "looks" for the timing trigger word. When it occurs, the analyzer triggers and begins collecting data. After 1000 samples are collected, the analyzer flashes the message DONE and displays the results. To switch displays between timing and state analyzers, press the **S2** and **S1** keys.

APPLICATION

As an example of linking the state analyzer to the timing analyzer, consider a process control application. Here, this type of linkage could be used to monitor the control signals generated as a result of a specific subroutine being executed.

DISABLING THE L BIT

With the timing display on the CRT, access the ARM field by pressing the **A** key. Step to the LINKAGE field and select **NONE**. (Once in the LINKAGE field, pressing the **DEFAULT** key is another way to do this.)

LINKING TIMING TO STATE

Return to the CONFIGURATION LIST and press the F1 key to call the state menu. Using the L bit in the trigger qualifier field, any sequential trigger word in the state analyzer's 16-level trigger word stack can be linked to occurrences in the timing domain. Use the **NEXT** key to step down to level 1. Then use the **SPACE BAR** to access the L bit, which is the last bit in the trigger qualifier. Set this bit to 1 as shown in Figure 6-34.

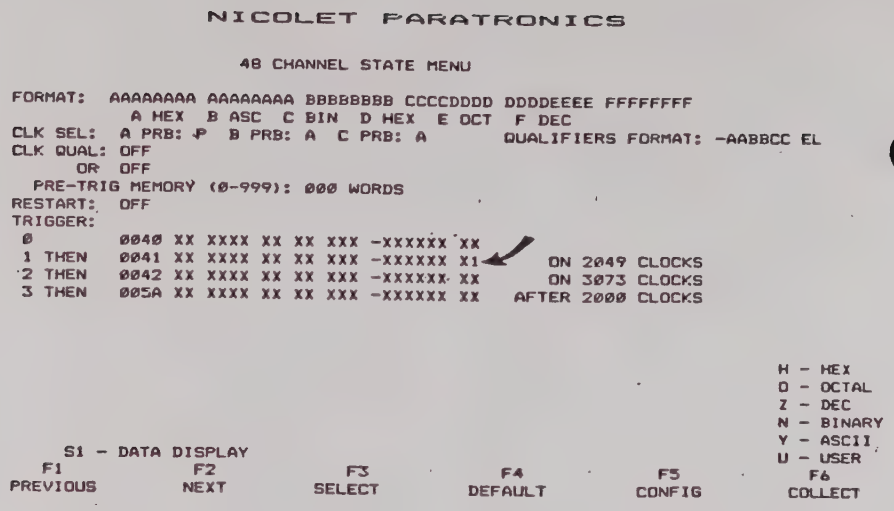

NICOLET PARATRONICS
48 CHANNEL STATE MENU
FORMAT: AAAAAAAA AAAAAAAA BBBBBBBB CCCCDDDD DDDDEEEE FFFFFFFF
A HEX B ASC C BIN D HEX E OCT F DEC
CLK SEL: A PRB: P B PRB: A C PRB: A QUALIFIERS FORMAT: -AABBCC EL
CLK QUAL: OFF
OR OFF
PRE-TRIG MEMORY (0-999): 000 WORDS
RESTART: OFF
TRIGGER:
0 0040 XX XXXX XX XX XXX -XXXXXX XX
1 THEN 0041 XX XXXX XX XX XXX -XXXXXX X1 ON 2049 CLOCKS
2 THEN 0042 XX XXXX XX XX XXX -XXXXXX XX ON 3073 CLOCKS
3 THEN 005A XX XXXX XX XX XXX -XXXXXX XX AFTER 2000 CLOCKS
H - HEX
O - OCTAL
Z - DEC
N - BINARY
Y - ASCII
U - USER
S1 - DATA DISPLAY
F1 PREVIOUS
F2 NEXT
F3 SELECT
F4 DEFAULT
F5 CONFIG
F6 COLLECT

Figure 6-34. Linking the state analyzer's TRIGGER LEVEL 1 to the timing analyzer.

COLLECT

Press the **COLLECT** key and watch the trigger status messages go through the following sequence:

TIMING:	SAMPLING	**STATE:**	LEVEL 0/1
			LEVEL 0/1
	ARMED		
	TRIGGERED ----------		LEVEL 1
	(LINKAGE)		
	DONE		LEVEL 2
			LEVEL 3
			TRIGGERED
			DONE

Notice how the state analyzer automatically restarts at level 0 until the timing analyzer completes its triggering sequence. When this happens, the state analyzer advances through the trigger stack.

Press the S2 and S1 keys to switch between state and timing displays. As an example, this type of linkage could be used to monitor the subroutine called by the occurrence of an interrupt. You are encouraged to experiment with other linkage set-ups.

NOTE: Linkage conditions should not be set in both analyzers simultaneously. (Neither analyzer will trigger.)

6.6.23 EXPAND (E)

Press S2 to obtain timing data. Notice the expansion cursor E positioned just above the center graticule. This is used to define the position from which the display will be expanded. Press F2 to sweep the symbol toward the center of the display at location 500, Figure 6-35. (Use F1 to step back if you overshoot). Press the Magnification Keys 1-5 to expand the picture as required.

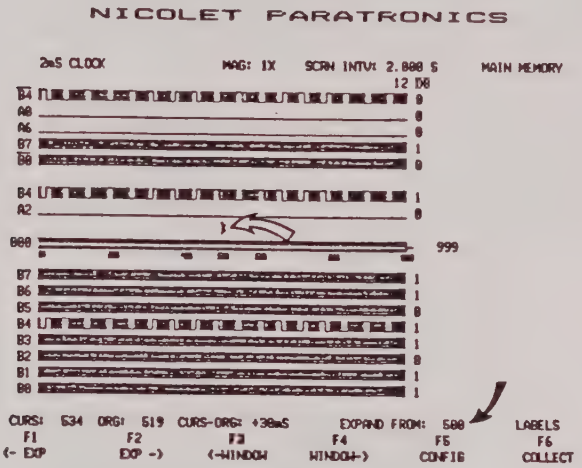


Figure 6-35. Timing display with the expansion symbol, E, at location 500.

6.6.24 8 CHANNEL GLITCH MEMORY MODE

The NPC-800's 8 CHANNEL GLITCH MEMORY mode allows you to capture 3 nS glitches and display them along with 8 channels of data. It is important to distinguish between this mode and the conventional 3 nS glitch latch capabilities of the previously described 16-channel timing/state configuration which does not incorporate a separate glitch memory. In the conventional 3 nS latch mode, the analyzer "remembers" the previous sample and arms a latch to capture any transitions occurring before the next sample clock edge. If a transition does occur, the latch is set and sampled at the next clock edge. In the case of a narrow glitch whose width is less than the clock sample period, the display will show the glitch as one clock period wide. See Figure 6-35.

LATCH MODE

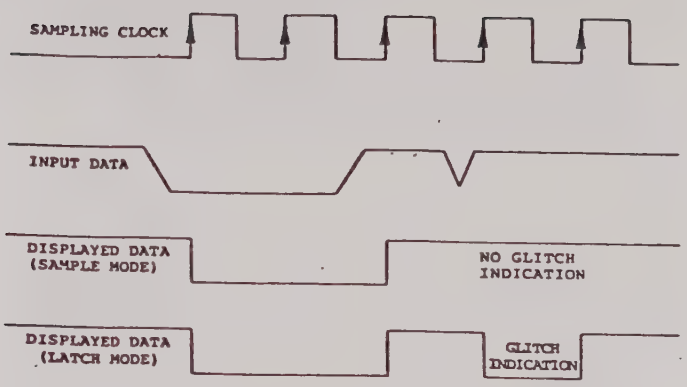


Figure 6-36. Sample and latch mode timing.

When using the NPC-800's 8-CHANNEL GLITCH MEMORY mode configuration, the analyzer splits its 1000-word, 16-channel memory into an 8-channel data memory plus an 8-channel glitch memory. Using the A timing probe only, glitches of 3 nS duration or longer that occur between sample clock edges are stored in the separate glitch memory. Upon display, a glitch is shown as a vertical line interspersed with the data. See Figure 6-37.

GLITCH MEMORY

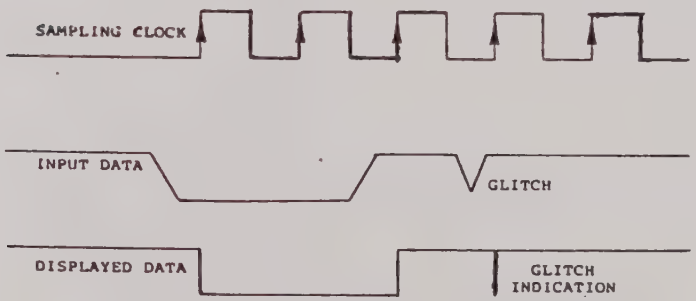


Figure 6-37. Glitch interspersed with data.

Press the CONFIG key. Select the 8 CHANNEL TIMING GLITCH mode from the CONFIGURATION LIST. Set in a clock of 1 mS and a pretrigger value of 00%.

COLLECT
S2

Press COLLECT to take a data collection. Press the S2 key i necessary to display timing data. With the timing data displayed a X20, move the window (if necessary) to obtain a display similar t Figure 6-36. Notice the glitch indications on channel A0. The us of the relatively slow (2 mS) clock allows the "glitches" to b viewed since the definition of a glitch is any transition whic occurs between sample clocks. (If you don't get at least 1 "glitch on channel A0, press COLLECT again or use a 2 mS clock.)

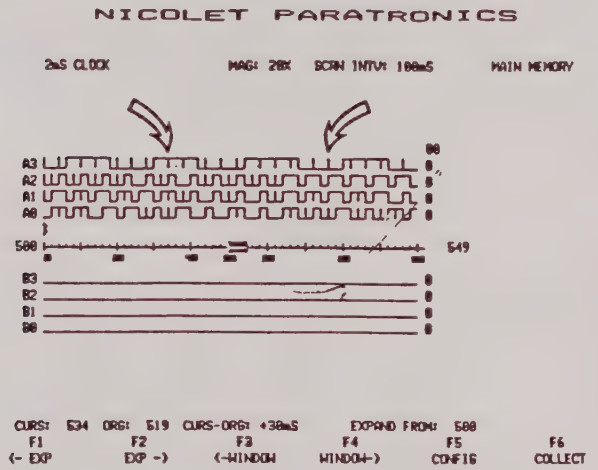


Figure 6-38. Timing display with glitches. (Your display will differ since no trigger word was specified.)

6.6.25 EDGE QUALIFICATION

Figure 6-39 shows the position of the edge qualifying field in the menu. This can be used to qualify an ARM or TRIGGER word. The options available are:

To demonstrate this feature, set up the timing menu as shown in figure 6-38. Press the F3 key to select a rising edge qualifier. Connect the A state probe to the A side of the test card and the A timing probe to the B side of the test card. Press F6 and COLLECT data. Now hold the shorting wire onto the input point of channel 33 of the timing probe. Press F6 again - this time the analyzer does not trigger. Remove the shorting wire and the analyzer will complete its trigger sequence.

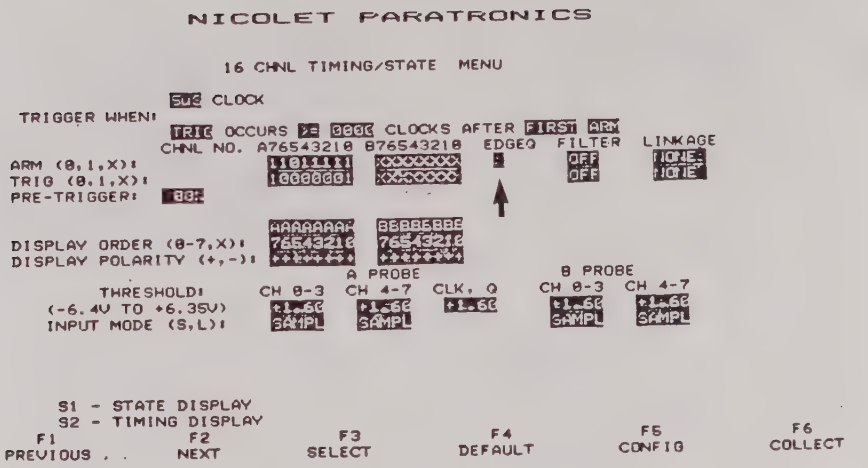


Figure 6-39. Position of edge qualification field in menu.

USING THE QUALIFIER

The explanation can be seen by examining Figure 6-40. The A group of bits are those connected to the B side of the test card. Channel shows the input to channel 33 of the timing probe. To meet the triggering specification, it is necessary for the trigger word to be seen and the input to channel 33 (the qualification input channel) to have a rising edge. When the shorting wire was connected to channel 33, the qualification could not be met and the analyzer failed to trigger. Removal of the shorting wire allowed the analyzer to complete its sequence.

This is a very useful parameter to help with the analysis of hardware.

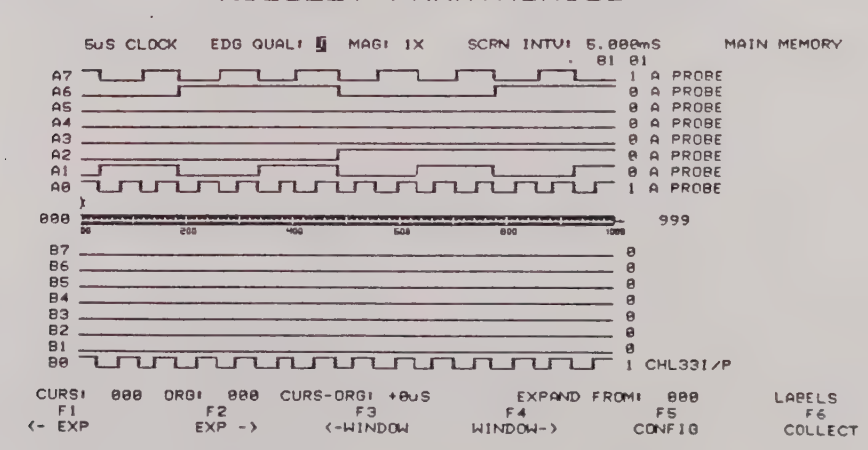


Figure 6-40. Timing Diagram showing the data input from the test card channels A0-A7 and the input to the edge qualifier channel 33 on the probe, show as B0 above.

6.7 BASIC WAVEFORM ANALYSIS (OPTIONAL WAVEFORM ANALYZER MUST BE INSTALLED)*

To demonstrate the basic waveform recording features of the NPC-800, the user need only set the desired sample period, connect the scope probe to the waveform test point on the test card, and press **COLLECT.** After the data collection, the captured waveform may be magnified, measured, and stored in a manner similar to the timing diagram display discussed previously. In addition, voltage information is displayed.

6.7.1 WAVEFORM MODE

Press the **CONFIG** key and step down to the mode labeled WAVEFORM RECORDER. Press the **WAVEFORM (F1)** key to call the waveform menu. Connect the Model 90 scope probe to the WAVEFORM BNC at the rear of the NPC-800. Set the probe switch to the X10 position.

Note that the waveform menu contains typical oscilloscope-type parameters. Since the default values are not appropriate for this example, these values should be changed as shown in Figure 6-39. Use keys **F3** and **F4** to change parameters in the waveform menu.

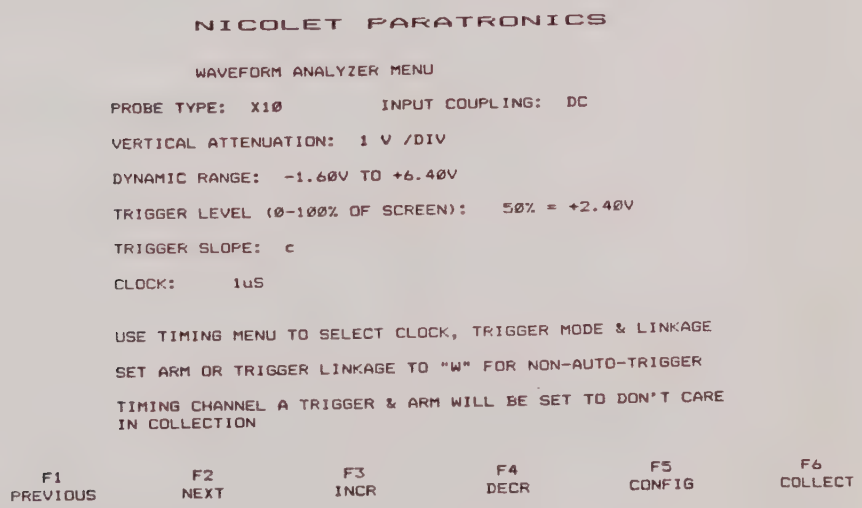

NICOLET PARATRONICS
WAVEFORM ANALYZER MENU
PROBE TYPE: X10
INPUT COUPLING: DC
VERTICAL ATTENUATION: 1 V /DIV
DYNAMIC RANGE: -1.60V TO +6.40V
TRIGGER LEVEL (0-100% OF SCREEN): 50% = +2.40V
TRIGGER SLOPE: c
CLOCK: 1uS
USE TIMING MENU TO SELECT CLOCK, TRIGGER MODE & LINKAGE
SET ARM OR TRIGGER LINKAGE TO "W" FOR NON-AUTO-TRIGGER
TIMING CHANNEL A TRIGGER & ARM WILL BE SET TO DON'T CARE IN COLLECTION
F1 PREVIOUS
F2 NEXT
F3 INCR
F4 DECR
F5 CONFIG
F6 COLLECT

Figure 6-41. Waveform menu for this example.

CLOCK (1 uS)

Press the S2 key followed by the C key. This will automatically call up the timing menu and activate the clock field. Now press the **SLOWER or FASTER** key and set the clock to **1 uS.**

---

*NOTE: A baseline in the waveform display will **not** be present if the **COLLECT** key is pressed when this option is not installed.

COLLECT

Hold the probe tip at the junction of the resistor and capacitor on the A side of the test card (test point labeled WF) and press **COLLECT**. Remove the probe.

With X1 magnification selected to view the entire 1000 sample data collection, the waveform should be as shown in Figure 6-42. Use the other magnification keys and the **WINDOW** and **CURSOR** keys to examine the collected data in detail and make timing and voltage measurements. Return to a 1X magnification.

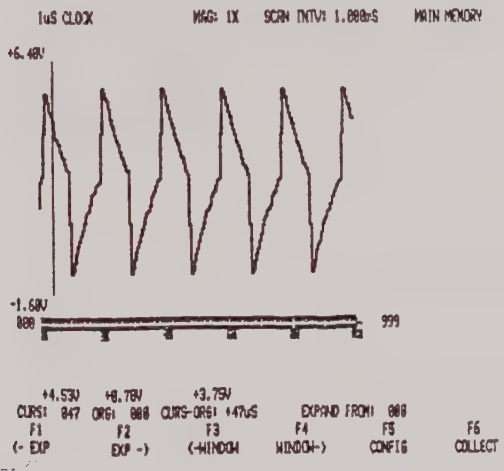


Figure 6-42. Waveform display at 1X magnification.

AUTO-TRIGGER

In the above example, the waveform analyzer was in the auto-trigger mode. That is, the 1 uX clock begins sampling the analog signal as soon as the **COLLECT** key is pressed without regard to the trigger level and slope of the signal. This free-running mode can be inhibited by setting the ARM or TRIGGER linkage field in the timing menu to **W**. In this manner, only incoming analog signals that meet the triggering conditions of the waveform menu will be collected. See Section 6.3.4, Advanced Waveform Examples, for additional information.

NOTE: Linkage conditions should not be set in both analyzers simultaneously. (Neither analyzer will trigger.)

Nicolet

(415) 490-8300 TWX 910-381-7030

December 5, 1984

NOTICE

ATTENTION: User

When using the waveform option in your Model 800 Analyzer, insure that both timing probes (M81A's), are plugged into your analyzer timing ports. Thank you.

Please install this page into the waveform section of your manual.

Nicolet Paratronics Corporation
201 Fourier Avenue
Fremont, California 94539

6.7.2 ADVANCED WAVEFORM EXAMPLES (OPTIONAL WAVEFORM BOARD MUST BE INSTALLED)*

In this section, the optional waveform analyzer will be used to monitor the composite video signal coming from the video BNC connector of the NPC-800. In addition, the LINKAGE field in the timing menu will be set to W to illustrate the "single-shot" storage capability of the waveform analyzer.

WAVEFORM MODE

Press RESET and select the WAVEFORM RECORDER mode when the CONFIGURATION LIST appears.

WAVEFORM MENU

```
                    NICOLET PARATRONICS

                  WAVEFORM ANALYZER MENU

PROBE TYPE:  X1Ø          INPUT COUPLING:  DC

VERTICAL ATTENUATION:  2ØØmV /DIV

DYNAMIC RANGE:  -Ø.64V TO +Ø.96V

TRIGGER LEVEL (Ø-1ØØ% OF SCREEN):   95% = +Ø.88V

TRIGGER SLOPE:  c

CLOCK:   1ØØnS

USE TIMING MENU TO SELECT CLOCK, TRIGGER MODE & LINKAGE

SET ARM OR TRIGGER LINKAGE TO "W" FOR NON-AUTO-TRIGGER

TIMING CHANNEL A TRIGGER & ARM WILL BE SET TO DON'T CARE
IN COLLECTION

F1          F2          F3          F4          F5          F6
PREVIOUS    NEXT        INCR        DECR        CONFIG      COLLECT
```

Figure 6-43. Waveform menu for monitoring the NPC-800's video signal.

CLOCK (100 nS)

Press the S2 key followed by the C key to call the timing menu with the cursor at the clock field. Use a 100 nS sample clock.

***NOTE:** A baseline in the waveform display will not be present if the COLLECT key is pressed when the Waveform Option is not installed.

SINGLE-SHOT MODE (W)

Use the **NEXT** key to step to the TRIG LINKAGE field. The use the **SELECT** key to enter a **W** into this field. Use the **NEXT** key again to step down to the PRETRIGGER field. Enter in a **0** for a pretrigger value of **00%**. See Figure 6-44.

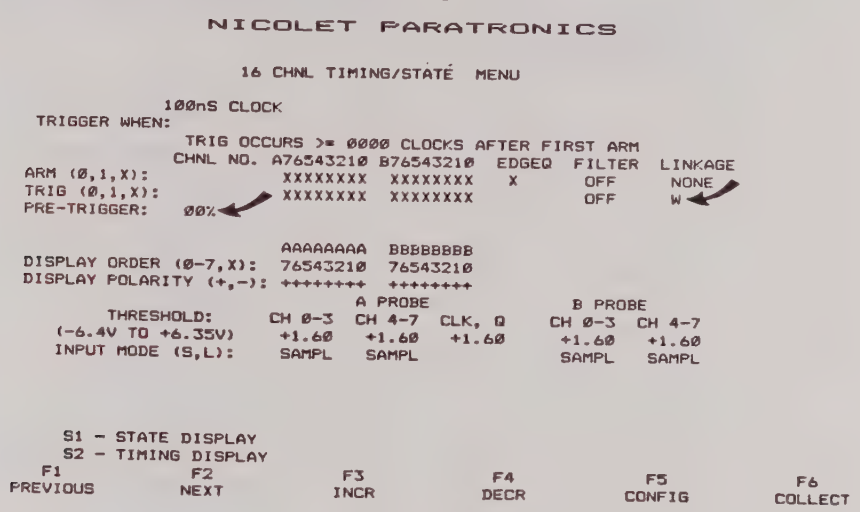

NICOLET PARATRONICS
16 CHNL TIMING/STATE MENU
100nS CLOCK
TRIGGER WHEN:
TRIG OCCURS >= 0000 CLOCKS AFTER FIRST ARM
CHNL NO. A76543210 B76543210 EDGEQ FILTER LINKAGE
ARM (0,1,X): XXXXXXXX XXXXXXXX X OFF NONE
TRIG (0,1,X): XXXXXXXX XXXXXXXX OFF W
PRE-TRIGGER: 00%
AAAAAAAA BBBBBBBB
DISPLAY ORDER (0-7,X): 76543210 76543210
DISPLAY POLARITY (+,-): ++++++++ ++++++++
A PROBE B PROBE
THRESHOLD: CH 0-3 CH 4-7 CLK, Q CH 0-3 CH 4-7
(-6.4V TO +6.35V) +1.60 +1.60 +1.60 +1.60 +1.60
INPUT MODE (S,L): SAMPL SAMPL SAMPL SAMPL
S1 - STATE DISPLAY
S2 - TIMING DISPLAY
F1 PREVIOUS
F2 NEXT
F3 INCR
F4 DECR
F5 CONFIG
F6 COLLECT

Figure 6-44. Timing menu set-up for waveform example.

NO INPUT SIGNAL

In the NPC-800, the timing menu is used to set up the waveform sample period and linkage. Setting a **W** into the LINKAGE field means that all triggering conditions associated with the waveform menu (such as threshold and slope) must be satisfied by the incoming analog signal in order to trigger the analyzer. Make certain that the Model 90 probe is set to X10 and plug it into the rear BNC connector labeled **WAVEFORM.** With the ground clip attached to the body of any rear BNC connector, and the Model 90 probe tip unconnected, press **COLLECT.** Note that the waveform display is blank and the status message ARMED flashes on the CRT. This means that the **W** (or linkage) conditions are not being satisfied, so the waveform analyzer is inhibited from triggering.

VIDEO INPUT

Insert the probe tip into the rear BNC connector labeled **VIDEO.** Then press the **COLLECT** key to get a "clean" data collection. At 1X magnification, the display should look approximately as shown in Figure 6-45. The negative-going pulse after the video pulse group is the horizontal sync pulse. (Note: Since the video signal levels can vary from unit-to-unit, you may have to adjust the waveform menu settings slightly to match Figure 6-45.)

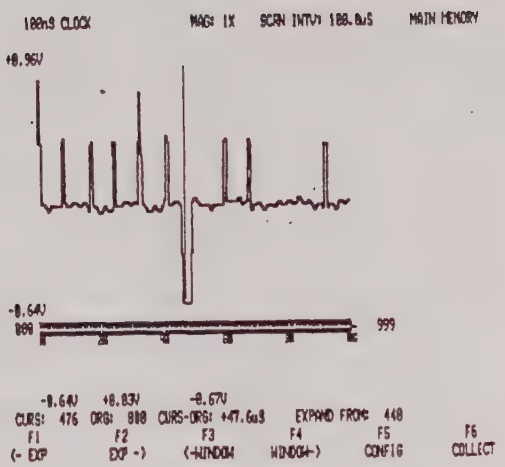


Figure 6-45. Video signal at 1X magnification.

EXPAND

Press the X2 (2), X5 (3), X10 (4), X20 (5) keys to view the video signal at different magnification factors. Return to X1 magnification and press the **EXPAND** key until the EXPAND FROM indictor at the lower-right-corner of the CRT corresponds to the approximate position in memory of the sync pulse. (No E symbol is sed in the waveform display.) Then press the X10 (4) key. Next press the **WINDOW** or keys as required to center the sync pulse. See Figure 6-46.

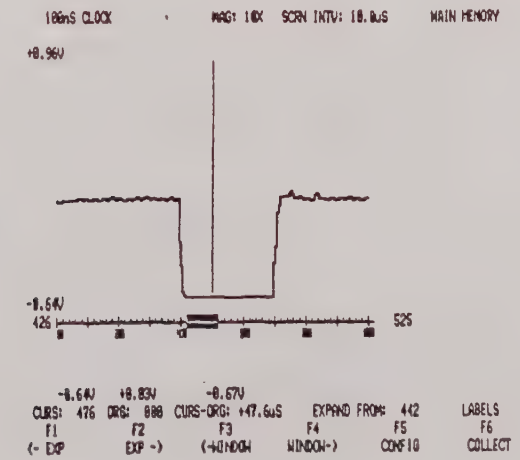


Figure 6-46. Examining the sync pulse at X10 magnification.

Return to 1X magnification and use the **EXPAND** key to return the EXPAND FROM indicator to 000. Then press the X20 key to again view the video pulse group at X20 magnification.

SAVE (S)

Press the **SAVE (S)** key to store the waveform and menu in the auxiliary memory. Then press the **COMPARE (X)** key to compare main and auxiliary memories. Return to the main memory by pressing the **MEMSEL (M)** key as required. Next press **COLLECT** to take another data collection. Use the **X** key to compare the new collection with the reference collection. (There should be differences in both amplitude and time.) Figure 6-47 shows the screens for Main and Aux memories, note the difference in waveforms. Your example will probably differ.

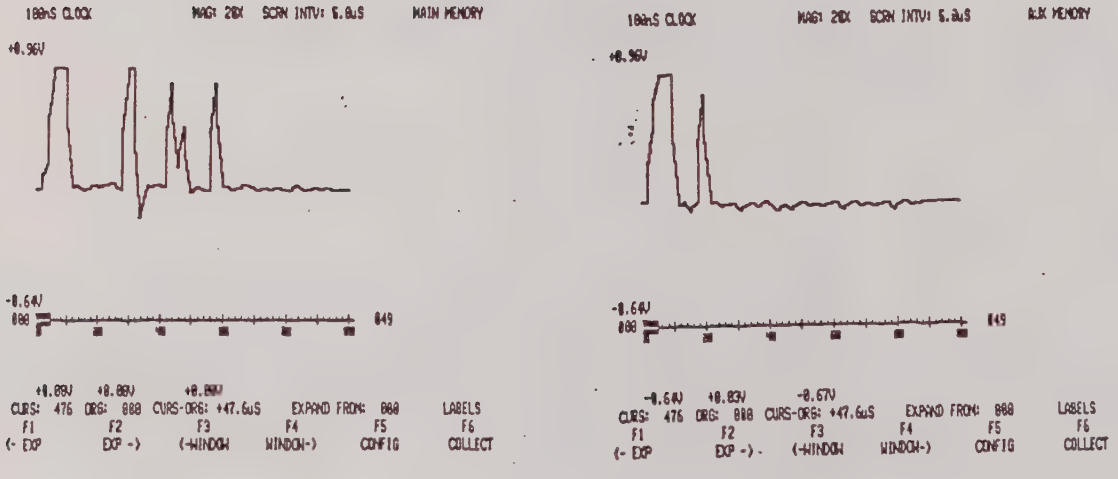


Figure 6-47A and 6-47B. Main and Auxiliary Memory Displays.

MEASUREMENTS

Locate the cursor by pressing the **L** key. Experiment with making voltage and time measurements in the main and auxiliary memories using the cursor. The **ORIGIN (O)** key can be used here to relocate the origin from 000 to any cursor location.

6.8 BASIC COUNTER-TIMER/ SIGNATURE ANALYSIS (OPTIONAL CT/SA BOARD MUST BE INSTALLED)*

To demonstrate the basic features of the optional counter-timer and signature analysis functions of the NPC-800, the Model 90 probe is used to monitor signals on the test card. Connect the probe to the rear panel input connector labeled CTSA. Set the Model 90 probe for X10 operation.

6.8.1 BASIC COUNTER/TIMER EXAMPLE

This section illustrates the use of the NPC-800 to make frequency (or period) measurements and totalize events using the Model 90 probe.

MENU

Press the **CONFIG** key and step down to the COUNTER-TIMER mode. Then press the **SELECT** key to display the COUNTER-TIMER menu. See Figure 6-48.

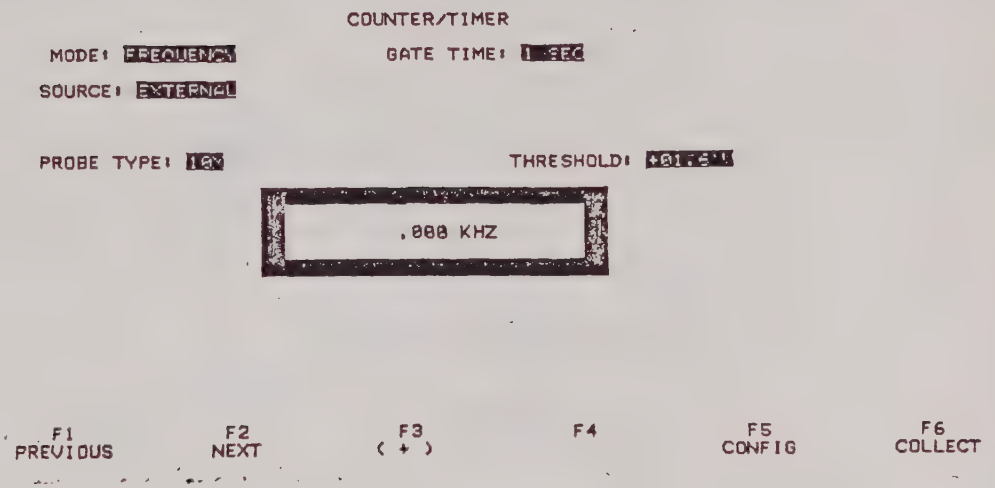


Figure 6-48. COUNTER-TIMER menu.

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*NOTE: The rectangular display window will be blank if the CT/SA option is not installed.

6.8.2 ADVANCED COUNTER-TIMER EXAMPLE

In addition to the basic use of the counter-timer to measure simple events using the Model 90 probe, the NPC-800 can be used to make counter-timer measurements of bus or other state events as monitored by the three state probes.

STATE-RELATED MEASUREMENTS

Frequency, period, and count measurements can be made by specifying a cyclical or repeating data word or event; interval measurements can be made by specifying two data words or events. In both cases, the data word can be specified as having up to 56 bits. These include 48 bits of data from the A, B, and C channel probes and eight additinal bits of clock qualifiers: six (two each) from the A, B, and C channel probes (AABBCC), one external trigger bit (E), and one linkage bit (L). The following procedure illustrates the use of the counter-timer for state-related measurements. As before, the A state probe should be plugged into the A side of the test cards.

FREQUENCY

Using F1 or F2 move to the mode field and select frequency with the **F3** key.

SOURCE: DATA

Next, step the cursor to the SOURCE field and select DATA. When DATA is the source, the field for the data word is automatically displayed in the format previously selected in the state menu. Then enter the data word: 0040 (rest X's). See Figure 6-49.

COLLECT

Press the **COLLECT** key to begin the counter-timer. Notice that the display indicates the frequency of occurrence of the specified data word being monitored by the A probe. (The remaining bits of the B and C channel probes are each set to DON'T CARE as are the clock qualifier bits AABBCC EL.) Pressing the **HOLD (F4)** key will cause the last measurement to be held on the display. Pressing **COLLECT** again will cause the counter-timer to resume making measurements.

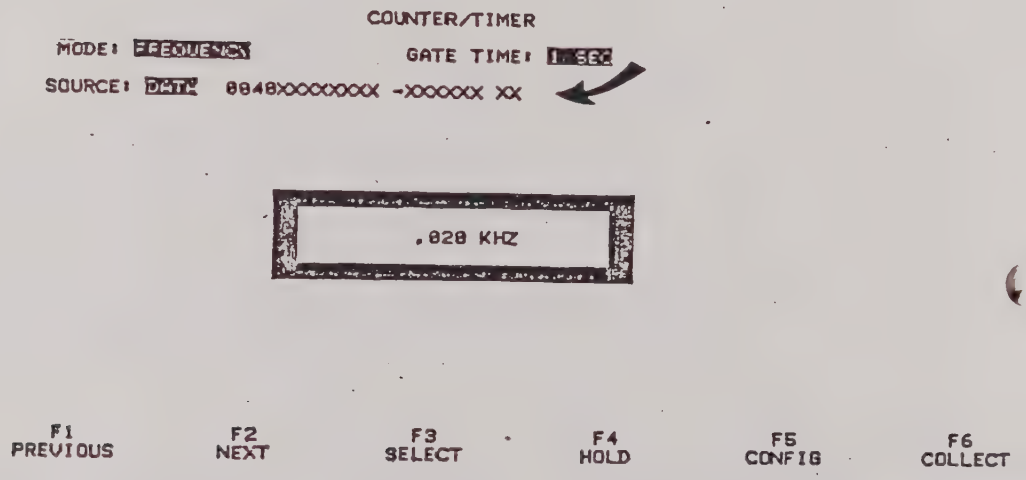

Figure 6-49. Counter-timer display indicating the frequency of occurrence of a specified data word.

SELECT

Move the cursor through the menu and back to the MODE field. Note that the counter-timer remains functioning and collecting even while the cursor is moved within the menu. Press the **SELECT** key to change modes to PERIOD, INTERVAL, and TOTAL and watch the display reflect the mode selected.

As in basic counter-timer example, pressing the **HOLD** key holds the measured data; while pressing the **COLLECT** key restarts the measurement.

INTERVAL MODE

All of the modes with the exception of INTERVAL require only a single event. As the name implies, INTERVAL refers to the time between two events and thus requires two data words: START and STOP. When the INTERVAL mode is entered, the fields for two data words are displayed. The fields are identical to those of the single data word--48 bits plus 8 additional qualifiers.

COLLECT

Select the INTERVAL mode and step the cursor to the SOURCE field. Enter **0040** (rest X's) and **00FF** (rest X's) in the START and STOP fields, respectively. When finished, press the **COLLECT** key and watch the display indicate the interval (in uS) between the two data words. See Figure 6-50. Note that the interval timer will continue making and displaying measurements until the **HOLD** key is pressed.

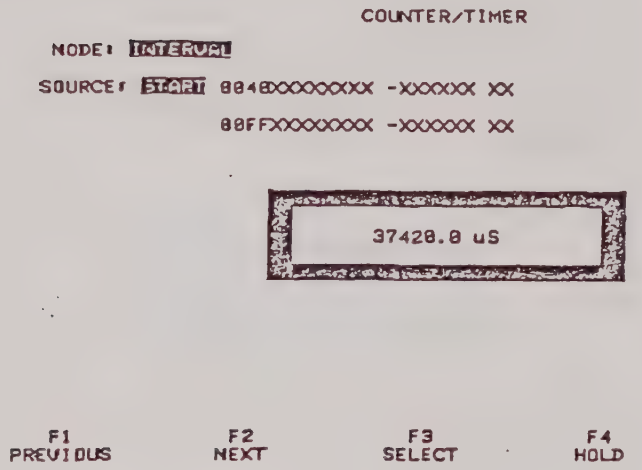

Figure 6-50. Counter-timer measurements of the interval between START and STOP data words.

FREQUENCY

When the counter-timer menu is first displayed, the cursor is automatically placed in the MODE field. Use the FREQUENCY mode fot the next step.

You're now ready to make a frequency measurement. Take the probe and hold it on the data line DB0, on the test card (A channel side) and watch the NPC-800 as it displays the frequency. See Figure 6-51. Notice the message COLLECTING that appears under the counter-timer display, indicating that the NPC-800 is in a real-time measurement mode.

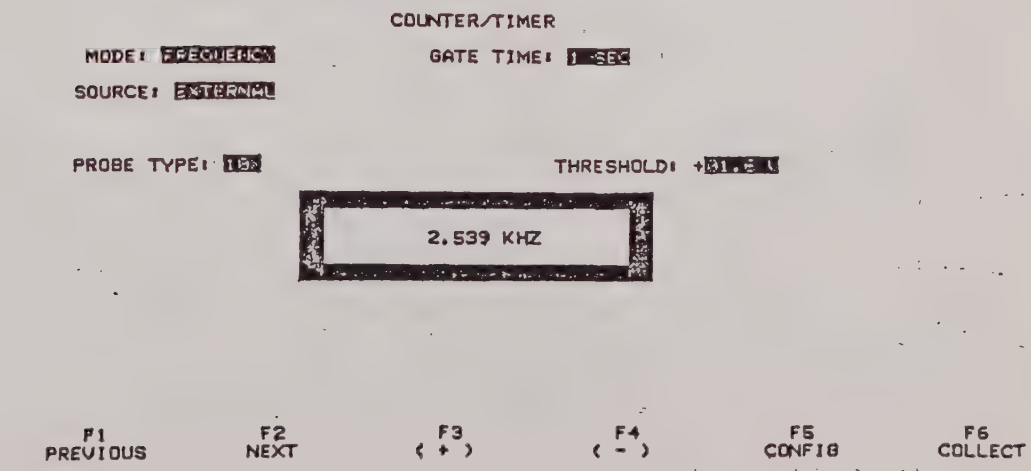

Figure 6-51. Frequency measurement using the counter-timer.

PERIOD

With the cursor in the MODE field and the probe still on DB0, use the **SELECT** key to change the mode to PERIOD. Notice that the display now measures in units of time (usec) instead of frequency (KHz). Also, note that the GATE TIME field changes to RANGE when the mode is changed to PERIOD. The GATE TIME indicates the interval over which the frequency is measured and also the interval between display updates. The RANGE indicates the maximum period which can be measured. See Figure 6-52.

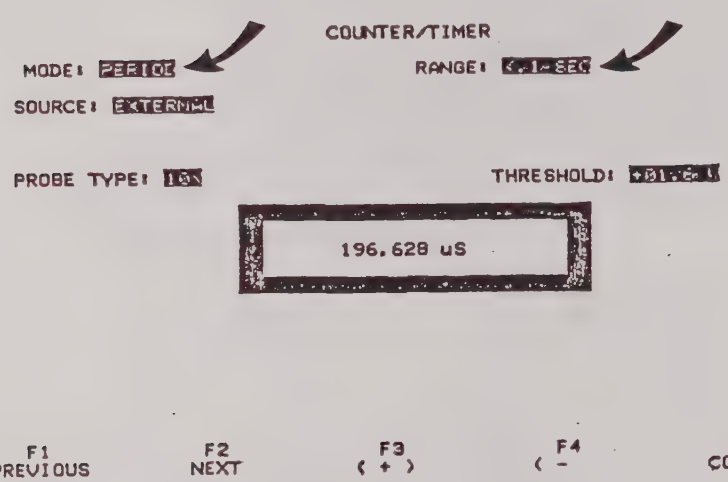

Figure 6-52. Period measurement using the counter-timer.

FORCE DISPLAY (F)

Next, press the **HOLD** key **(F4)**. This causes the display to hold the last measurement and displays the message HOLDING under the value. Press the **COLLECT** key to restart the counter-timer. The message COLLECTING will again appear under the counter-timer display.

PROBE AND THRESHOLD

The other two parameters which were used--PROBE TYPE and THRESHOLD--set the voltage range of the input signal. If the probe setting and menu are both set to IX, the range of threshold settings which can be used is anywhere from -2.56V to +2.54V, in 0.02V increments. With a probe setting of 10X in the menu, and the Model 90 probe set to X10, the range of threshold voltages is from -25.6V to +25.4V, in .2V increments.

6.8.3 BASIC SIGNATURE ANALYSIS EXAMPLE

This section illustrates the basic signature analyzer features of the optional Counter-Timer/Signature Analyzer board. The NPC-800 can be used to perform the function of a traditional signature analyzer (Hewlett Packard 5004A or equivalent) which uses individual lines for start, stop, and clock signals. See Section 6.3.5.2 and below for additional discussion of the START and STOP signals.

DISCUSSION

Briefly, signature analysis is a trouble-shooting technique which uses a data compression algorithm to reduce a complex, serial data stream to a unique 4-digit signature. To develop a signature, a START bit, STOP bit, CLOCK, and a serial data signal are required. In most signature analyzers, each of these signals requires a single line connected to the circuit board being tested.

By comparison, the NPC-800 allows the use of up to 56 bits to define the START and STOP signals. (See Section 6.3.5.2) The CLOCK signal is specified in the state menu (A, B, and C clock edges and clock qualifiers) and the serial data signal is provided through the Model 90 probe connected to the rear panel input connector labeled CTSA.

The NPC-800's signature analyzer allows variable-threshold signal levels to be input to the serial data probe for testing logic other than TTL (i.e., ECL). It also allows a variable threshold implementation of START, STOP, and CLOCK signals using the adjustable threshold feature of the analyzer's probes.

SIGNATURE ANALYZER MODE

Press the **CONFIG** key and step down to the SIGNATURE ANALYZER mode. Press the **SELECT** key to display the SIGNATURE menu. See Figure 6-53. The fields of the SIGNATURE menu are SIGNATURE FORMAT, START, and STOP words, PROBE TYPE and THRESHOLD.

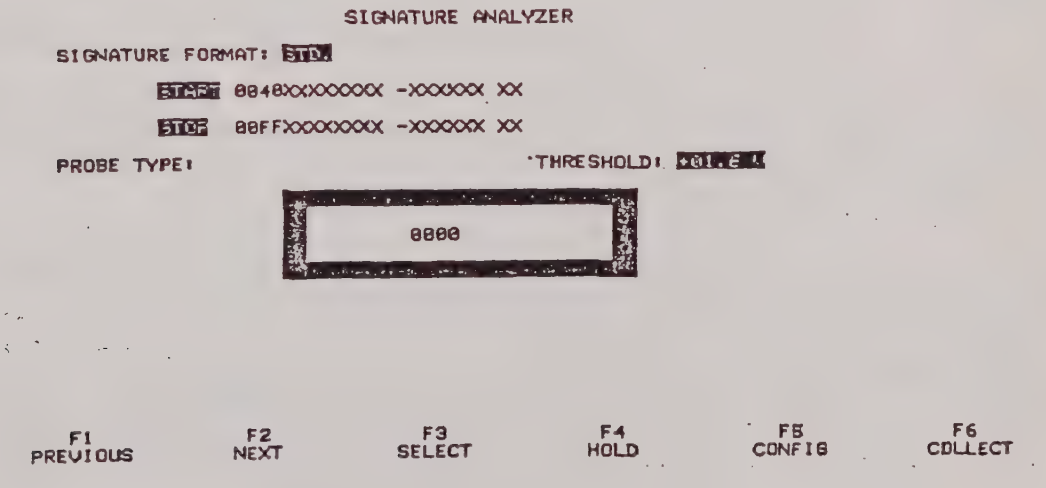

Figure 6-53. Signature analyzer menu and display.

FORMAT

Notice that the first field displays the STD signature format. STD refers to the Hewlett Packard seven-segment format which displays characters 0-9, A, C, F, H, P, U. (The HEX display format, which can be selected in this field, displays the hexadecimal characters 0-9, and A-F.)

START/STOP

Move the cursor to the START field using the **NEXT** or **PREVIOUS** keys as required. The START word is always displayed in the format used in the state menu. Press the **N (Binary)** key to display the START word in a binary format. Next, enter the single-bit START word **(0)** in the ninth bit position from the left. Press the NEXT key to move to the STOP field. Then press the **N (Binary)** key and enter the single-bit STOP word (1) in the same bit position as before. See Figure 6-54.

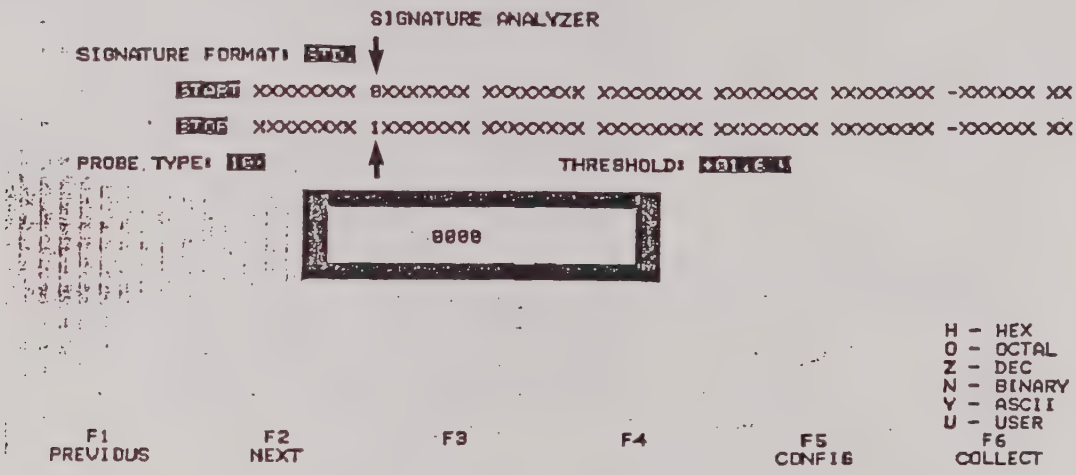

Figure 6-54. Use of single bit START and STOP words.

Note: **The use of a ZERO in the menu display above is equivalent to a ( ) signal on the HP-5004A, while the use of a ONE is equivalent to a ( ) signals.**

Connect the A and B state probes to the A and B outputs of the test card. Press the **COLLECT** key. A signature can now be taken for any serial stream on the test card in the interval between the single-bit START and STOP words.

SIGNATURES

When you want to take a signature of a test point, simply touch the circuit node of interest. For example, touch the Model 90 probe tip to the B channel data lines (labeled DB0-DB7), one at a time; the NPC-800 automatically displays the signature of the data line being tested. See Figure 6-55.

Note that each time you take a serial collection resulting in a **new** signature, the display underneath the signature reads UNSTABLE (changing) for approximately a second, before switching to STABLE. However, if the signature collection is the same for successive measurements, only the message STABLE is displayed.

Also note that the signature window displays REPEAT MODE above the signature. This is the automatic mode mentioned above. Press the **HOLD (F4)** key to hold the displayed signature; press the **COLLECT** key to return to the automatic mode.

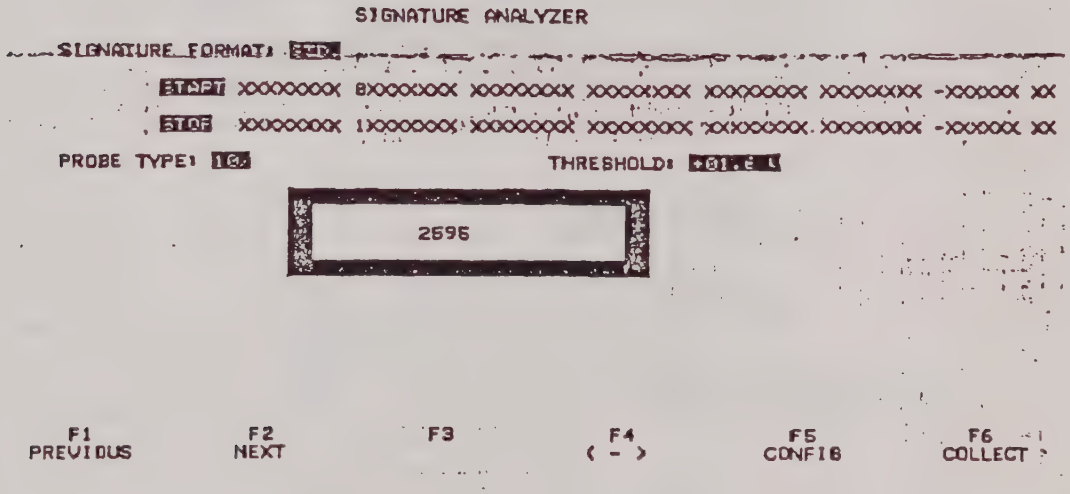

Figure 6-55. Display of signature for test point DB0 of the B channel. (Note: Your signature may differ since ther are several versions of the test card in the field.)

FAULT-ISOLATION

Using the REPEAT mode, let's generate a fault. With the probe on DB0 on the B channel side of the test card, place the shorting wire on pin 2 of U3. U3 is located at the top center of the test card. This fault changes the counting sequence of the B counter. Press **COLLECT** to obtain a new signature for test point DB0. Note that the new signature shown in Figure 6-56 differs from the signature in Figure 6-55.

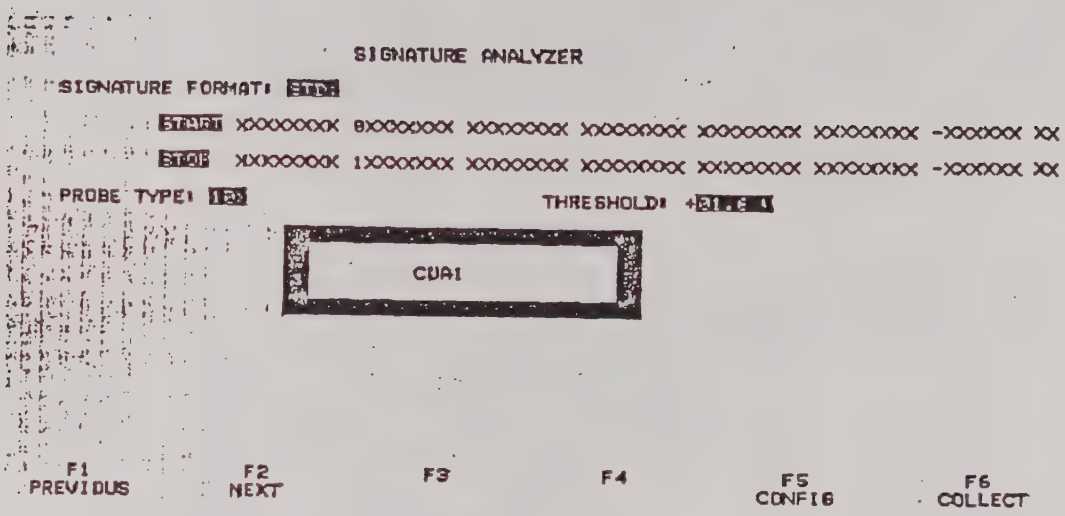

Figure 6-56. New signature for DB0 (B Counter).

ADVANCED SIGNATURE ANALYSIS EXAMPLE

The NPC-800's signature analyzer provides additional capabilities which could be used to test complex state sequences. Often, digital systems do not contain separate on-board start and stop signals representing complex events. The NPC-800's 56-bit-wide word recognition circuitry can be used to supply the necessary signals. (In the basic example of Section 6.2.4.2, a single bit was used for both start and stop signals.) For advanced applications, the entire 56-bit-wide trigger word--consisting of 48 data bits and 6 qualifiers from the data probes plus the E and L bits--can be used to control the signature analyzer. The E bit provides a single bit qualification for independent synchronization from a signal anywhere in the circuitry you're testing. The L bit provides a powerful linkage capability to one or more additional logic analyzers.

SOFTWARE SIGNATURES

As a practical example, the beginning and ending addresses of a software routine could be used to gate the signature analyzer. By placing the Model 90 probe on the LSB of the address word during program execution, a unique signature of the executing code is obtained. In this manner, faulty software of "unannonced" revs can be rapidly uncovered.

RS-232/IEEE-488 EXAMPLES

See Section 14.3, Transmission Examples

6.5 DISASSEMBLY EXAMPLE

In order to simplify the tracing of a microprocessor's program, NPC offers dedicated probes with disassembly software for most of the popular 8 and 16 bit microprocessors. (Our dedicated probes are described in general in Section 4.6.)

"DISASSEMBLING" THE TEST CARD

Even if you do not currently have a dedicated probe, you can still "disassemble" data patterns from the test card.

Connect the A and B state probes to corresponding connectors on the test card. Call the state menu and set the A-channel trigger to **0040.**

COLLECT

Press the **COLLECT** key and display the data in hexadecimal, or any other format desired.

CP/M DIR

Press the **CONFIG** key and then press ESC to call the CP/M operating system. When the cursor appears, type **CM2.** A secondary menu will be displayed. See Figure 6-57.

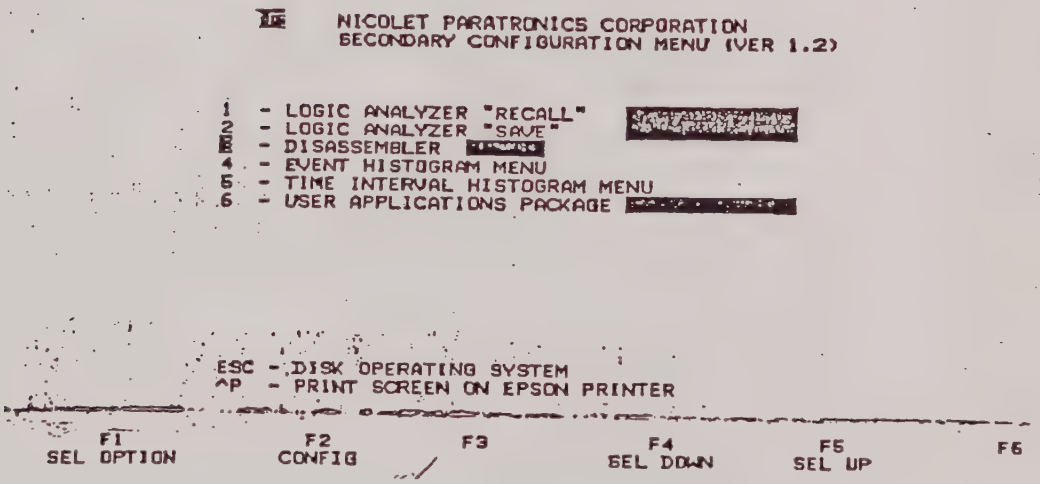

Figure 6-57. The secondary configuration menu used to select the disassembly software.

LOADING THE DISASSEMBLY SOFTWARE

Press **F4** (Select Down) key to move the cursor down to "3 **Disassembler."** Then use the **F1** key to select the Z80 disassembler to load to disassembler press **F3** (Load) key. Return to the CONFIGURATION LIST by pressing **F2** and return to the state analyzer using the **F1** key.

DISPLAYING IN DISASSEMBLED FORMAT

Pressing the **1** key will change the display format to disassembly. **Note:** Press the labels key and observe the **1** is a format option key together with **H, O, etc.**

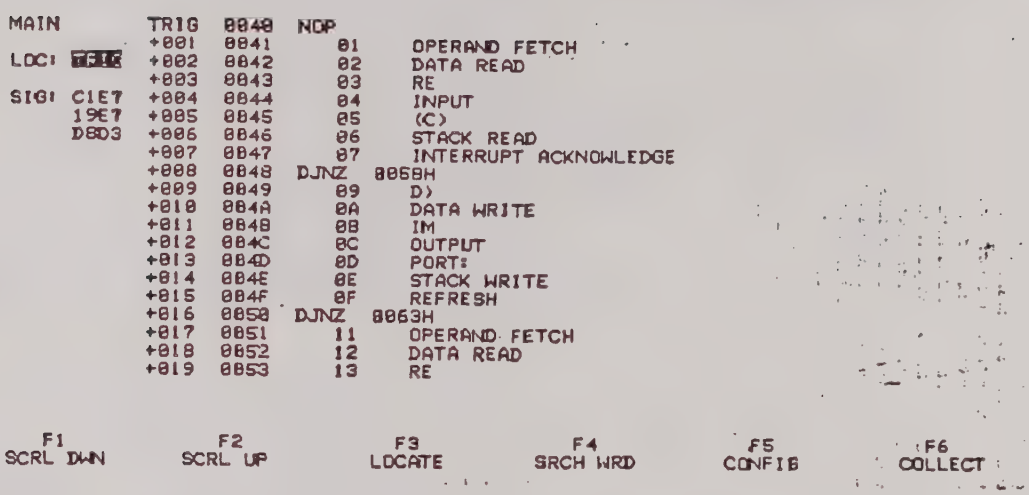
MAIN TRIG 0040 NOP
+001 0041 01 OPERAND FETCH
LOC: [illegible] +002 0042 02 DATA READ
+003 0043 03 RE
SIG: C1E7 +004 0044 04 INPUT
19E7 +005 0045 05 (C)
D8D3 +006 0046 06 STACK READ
+007 0047 07 INTERRUPT ACKNOWLEDGE
+008 0048 DJNZ 0058H
+009 0049 09 D)
+010 004A 0A DATA WRITE
+011 004B 0B IM
+012 004C 0C OUTPUT
+013 004D 0D PORT:
+014 004E 0E STACK WRITE
+015 004F 0F REFRESH
+016 0050 DJNZ 0063H
+017 0051 11 OPERAND FETCH
+018 0052 12 DATA READ
+019 0053 13 RE
F1 SCRL DWN
F2 SCRL UP
F3 LOCATE
F4 SRCH WRD
F5 CONFIG
F6 COLLECT

Figure 6-58. Disassembled display of arbitrary test card data. The Z80 disassembler was used for this example.

NOTE: The information in Figure 6-58 is meaningless since neither a dedicated probe nor a real microprocessor were used.

UNUSED STATE CHANNELS

Since our 8-bit dedicated probes require 32 channels (A & B), there are 16 additional state channels (c) (and 16 additional timing channels) available for monitoring other signals in your system. To view these additional state channels, simply type the key corresponding to the desired display format. (See the LABELS field.)

USER FORMAT (U)

For example, if you are using a mixed format, type U to call all 48 channels (A, B, and C) of state data in that format. Then type 1 to again disassemble the data associated with the A and B probe inputs.

If you should require additional information or assistance, contact our Applications Engineering department at:

(800) 642-6538 (Toll-free outside California)

(415) 490-8300 (California)

(910) 381-7030 (TWX)

NICOLET PARATRONICS CORPORATION
201 Fourier Avenue
Fremont, California 94539

9.0 GENERAL-PURPOSE COMPUTER

As described in the introduction, the NPC-864MSTWC is not only a very capable logic analysis system, it is also a general-purpose, desk-top microcomputer. Since the logic analyzer has been thoroughly described in previous sections of this manual, this section, as well as Sections 10.0 and 11.0, will deal only with the microcomputer aspects of the NPC-864MSTWC.

All microcomputers are comprised of a hardware system and a software system. Unless used for a single, specific task, the software system is called an "operating system." The purpose of an operating system is to provide the interface between the hardware and the user.

9.1 HARDWARE

DISPLAY

There are three display techniques available to the user. The integral display is a 9-inch CRT with 25 lines of 80 character positions each. There is a BNC connector on the back panel which permits the information on the CRT to also be displayed on an external video monitor or printer. The RS-232C interface provides a means of transmitting information to an external terminal or printer for display. See Section 12.0 for details on these output ports.

KEYBOARD

The keyboard is a full ASCII keyboard, which will be familiar to most users. There are 7 special function keys at the top of the keyboard, plus a **RESET** key. The **RESET** key calls the Logic Analyzer Operating System and must be held down for approximately 2 seconds to accomplish this function. This time delay is provided to prevent an accidental reset at an inopportune time. The other 6 special keys are predefined when operating the NPC-864MSTWC as a logic analyzer; or can be user-defined in the microcomputer mode.

MEMORY SUBSYSTEM

There are 48K bytes of RAM available to the user. Since the NPC-864MSTWC's 8085 microprocessor cannot directly address this 48K of RAM plus the 40K of analyzer ROM, the memories are "bank switched," enabling only one memory bank at a time.

DISK DRIVE

Both integral flexible disk drives are 5¼", double-sided, double-density, soft-sectored, 96 tracks per inch, 80 tracks, with 600K bytes of formatted capacity. Refer to Section 2.3.8.5 for the diskette specification. There is a connector provided to expand the disk memory to approximately 2M bytes, unformatted, by using an external dual-drive expansion chassis. The RS-232C interface can also be used to extend the disk memory using a serial driven disk subsystem.

I/O

The RS-232C interface on the NPC-864MSTC provides a "standard" interface to serial devices. This bidirectional interface is described in Section 12.0.

The NPC-864MSTWC also incorporates an intelligent controller for the IEEE-488 interface bus. The commands that permit the execution of user programs to control an IEEE-488 bus-based system are described in Section 13.0.

9.2 SOFTWARE

As stated previously, an "operating system" is a program designed to provide an interface between the user and the hardware. The NPC-864MSTWC actually has 2 operating systems, the logic analyzer operating system which is in ROM, and CP/M which is loaded from the disk into RAM. CP/M is a trademark of Digital Research.

The ROM-based operating system for the logic analyzer should require little explanation because the functions of this system are fixed and dedicated to the task of controlling the logic analyzer hardware.

On the other hand, the user interface to the microcomputer cannot be defined specifically because of the great diversity of application software available to be purchased or created by the user. Therefore, a description of CP/M is included in Section 10.0.

CP/M

CP/M is probably the single most commonly used operating system in the microcomputer world for the 8080, 8085, and the Z80 microprocessors. There are many reasonably priced programs available on the market that perform a wide variety of applications from word processing to scientific analysis of data.

Through CP/M, the user can also create his or her own programs. These programs can be machine-code-generated via assembly language by a resident assembler, or it can be generated using a high-level-language such as BASIC or FORTRAN. CP/M can also be used to set up and control the analyzer and then post-process the analyzer data. See Section 11.12 for an example of using CP/M to automate analyzer tests, including operator prompts.

9.2.1 OPTIONAL PRINTER PROGRAM

A printer driver program that enables the NPC-864MSTWC to generate text and graphics hardcopy using an Epson MX-80A printer is available. The printer must be equipped with "Graftrax" and a serial 2K buffer interface card. The driver software is provided on diskette and contains the following 3 files:

MX.80PRNT.COM (The program itself)
MX.80PRNT.DOC (Documentation concerning operation)

10.0 CP/M OPERATING SYSTEM

This Operator's Manual for the NPC-864MSTWC is intended to guide the user in the application of CP/M on the NPC-864MSTWC, not to provide a tutorial, nor to make the user proficient in its use. This section provides an overview of CP/M, and Section 11.0 provides simple, basic examples of some of CP/M's features and commands. For more detailed knowledge of CP/M and it's applications and/or modifications, refer to the CP/M Documentation Manual provided with the NPC-864MSTWC.

The CP/M operating system is literally a system of interrelated programs. Rather than load all of CP/M into memory at once and unnecessarily consume RAM memory space, the hardware memory is partitioned such that one section will contain the core of the operating system (hereafter referred to simply as "the system"), while the remaining programs will reside in an area of memory designated as "transient program area." These transient programs will be loaded into the shared memory only when needed.

There are 2 kinds of commands available in CP/M: built-in and transient. Built-in commands are five of the most commonly used commands which are part of the core of the CP/M system and do not appear on the directory of the disk. Transient commands are so named because they are actually programs that generally appear in the disk directory. When called, they are loaded into the transient program area (TPA) of RAM. Each transient program has its own set of commands which can be executed after loading into RAM is complete.

10.1 BUILT-IN COMMANDS

DIR DIR is the command used to display the directory of the disk.*

TYPE TYPE is the command used to simply examine a disk file by displaying the file on the CRT, exactly as it is stored on the disk.

SAVE SAVE is used to save a file onto the disk.

REN REN is used to rename an existing file on the disk. It will not create a new copy of the old file, merely assign a new name to it.

ERA ERA will erase an unwanted file from the disk.

10.2 TRANSIENT COMMANDS

SYSGEN SYSGEN is a program that will not appear in the disk directory. It is used to generate a new system disk, to be used as a backup copy. Due to copyright restrictions, CP/M may not be copied.

***NOTE:** The file labeled: **READ ME** describes the other files on the diskette. To access this file, type:

TYPE READ.ME

Then press **CNTL S** to stop scrolling; and any key to start.

STAT	STAT is a program which will display the remaining memory space on the disk or the size of a specific file.
ED	ED and its associated commands perform a simple text editor function. It is not a word processor, but a tool to use in the creation and editing of files. These files can be simple text or high-level programs to be compiled later.
PIP	PIP is a file handling and manipulation program. It is used to copy files, transmit and receive data on the RS-232C interface, and assign physical devices to logical device names used in PIP for file handling.
SUBMIT	SUBMIT is a program used to specify a series of CP/M commands to be executed sequentially. This series can be stored as a file, then called any time the user wishes to perform that series of commands--without having to type them from the keyboard each time.
XSUB	XSUB is an extended submit program which allows a series of commands to be linked into a file; and which also will stop and permit the user to insert variable information into specific elements of the command list.
ASM	ASM is an assembler program for the 8080/8085. It allows the user to create 8080/8085 code using assembly language. This 8080/8085 code thus generated may be used in the NPC-864MSTWC or it can be transmitted, using PIP, to an external device such as a PROM programmer. There are similar programs for other microprocessors available from software suppliers.
DDT	DDT is used to debug programs created with ASM. It will test the program, as well as permit editing.
SAVE	SAVE is used to transfer the transient program area of RAM memory to the disk. Normally this program would be used to save the programs generated by ASM.
LOAD	LOAD is used to convert a program from a ".HEX" file type created by ASM into an executable ".COM" file. As the conversion takes place, the program is loaded into executable memory space.
DUMP	DUMP is used to display a file from the disk in HEX form, rather than ASCII.

10.3 NPC TRANSIENT COMMANDS

CM2.COM — SECONDARY CONFIGURATION MENU THAT ALLOWS SELECTION OF:

1. Time Histogram
2. Event Histogram
3. Print routine for Epson MX-80 graphics printer on the RS-232 port
4. LASAVE.COM
5. LARECALL.COM
6. Disassemblers
7. Load and execute user supplied subprograms

UC2.COM — Sample user program that can be loaded and executed using CM2.COM. The program displays the NPC-800 legal character set.

UC2.LST — Source listing of sample user program UC2.COM.

D8080 — 8080 microprocessor disassembler software

D8085 — 8085 microprocessor disassembler software

D6800 — 6800 microprocessor disassembler software

D6809E — 6809E microprocessor disassembler software

D488 — IEEE 488 disassembler software

D8086 — 8086 microprocessor disassembler software

D68000 — 68000 microprocessor disassembler software

DZ80 — Z80 microprocessor disassembler software

FORMAT1.COM — Program to format a single-sided diskette for operation on the NPC-800 system; external drives only

FORMAT2.COM — Program to format and copy the CP/M operating system on a double-sided diskette on the NPC-800 system

KYBDTEST.COM — Program used to test the NPC-800 keyboard

LA.COM — Program used to return to the NPC-800 firmware from the CP/M disk operating system without resetting NPC-800

LASAVE.COM	Program used to save the NPC-800 set-up and collected data into a disk file FORMAT - LASAVE D:FILENAME.XXX
LARECALL.COM	Program used to recall from diskette the NPC-800 set-up and data stored by the LASAVE program FORMAT - LARECALL D:FILENAME.XX
LADISA.COM	Program used to load a disassembler from diskette for use by the logic state analyzer firmware FORMAT - LADISA D:FILENAME.XX
RAMTEST.COM	Program used to test the dynamic RAM and the state analyzer static auxiliary RAM

FILES TO BE EXECUTED UTILIZING THE CBASIC INTERPRETER

GPIBEX.BAS	The source code file of an example program that will exercise the GPIB functions of the NPC-800
GPIBEX.INT	The intermediate code file of an example program that will exercise the GPIB functions of the NPC-800
GPIB.BAS	Source file written in BASIC that can be included in a BASIC program to allow higher level access to the GPIB controller and device functions
LADISC.BAS	Source file written in BASIC that can be included in a BASIC program to allow the saving and recalling of NPC-800 set-up and data files from a BASIC program
RS232EX.BAS	The source code file of an example program that will exercise operating system control of the NPC-800 and exercise NPC-800 to NPC-800 operation over the RS-232 interface
RS232EX.INT	The intermediate code file of an example program that will exercise operating system control of the NPC-800 to NPC-800 operation over the RS-232 interface
RS232EX.001	LASAVE file used by RS232EX program
RS232EX.002	LASAVE file used by RS232EX program
SAVREC.ASM	Source file in 8085 assembly used by LADISC.BAS to allow SAVE/RECALL of analyzer data files
SAVREC.COM	COM file of SAVREC.ASM read by LADISC.BAS to perform LASAVE and LARECALL

FILES FOR COMPILATION BY CB-80

GPIBEX80.BAS	Source file written in CB-80 of an example program that will exercise the GPIB functions of the NPC-800
GPIBEX80.REL	A relocatable binary file generated from assembling GPIBEX80.BAS
GPIB80.BAS	Source file written in CB-80 that can be included in a BASIC program to allow higher level access to the GPIB controller and device functions
GPIBPS80.REL	A relocatable binary file that is used with the GPIB80.BAS file to allow higher level access to the GPIB controller and device functions. The routine provides call access to absolute addresses from CB-80 program.
GPIBPS80.MAC	The source program for GPIBPS80.REL file. It requires an assembler that generates a relocatable binary file.
LADISC80.BAS	Source file written in CB-80 that can be included in a BASIC program to allow the saving and recalling of NPC-800 set-up and data files from a CB-80 program
SAVREC80.MAC	A source file used with LADISC80.BAS to allow saving/recalling of NPC-800 analyzer data
SAVREC80.REL	A relocatable binary file generated by assembling file SAVREC80.MAC
GPIBEX80.COM	The executable file generated by compiling GPIBEX80.BAS BASIC program with CB-80

.0.4 USE OF LASAVE AND LARECALL FROM A CBASIC PROGRAM

A file is provided on floppy disk (named LADISC.BAS) which provides the function definitions necessary to save or recall analyzer set-ups and data while executing a CBASIC program. This is useful in automated testing for recalling canned set-ups or "known-good" data and to save results for later analysis.

To make use of these functions it is necessary to compile a CBASIC test program with LADISC.BAS included prior to the first program access. This can be done with the CP/M editor or at compile time by using the following CBASIC statement:

```
%INCLUDE LADISC
```

To execute LASAVE, use the statement format:

```
RC% = FN.LASAVE% ( filename$ )
```

To execute LARECALL, use the statement format:

```
RC% = FN.LARECALL% ( filename $ )
```

filename $ is any valid CP/M file name.

RC% will contain a return code, as follows:

0 = normal execution
1 = disc full (save only)
2 = no such filename (recall only)
3 = invalid filename

11.0 CP/M EXAMPLES

This section of the operating manual describes the steps needed to perform some of the more commonly-used commands that are available to the user. Although you will not receive an in-depth knowledge of CP/M and its facilities, the examples that follow will show you how to perform basic text file creation, limited file manipulation, 8080/8085 code generation and debug, and how to get a hardcopy of your files. You'll also be able to exercise control over the execution of logic analyzer tests saved on disk.

11.1 POWER ON

If the power is already on, it is not necessary to turn the power off and back on. Insert the CP/M diskette in accordance with Section 2.3.8, call the CONFIGURATION LIST, and press the ESC (ESCAPE) key. If the power is off, turn it on at the rear of the right side of the unit **BEFORE INSERTING THE DISKETTE.**

11.2 HEADER

The system will respond with a header identifying the current version of the CP/M operating system. The system will also display a prompt to signify that it is ready for operator input:

```
A
```

11.3 DIR

DIR is used to display the disk directory. Simply type DIR and press **RETURN:**

```
A DIR (RETURN)
```

The CRT should now display the contents of the disk:

```
DIR
A: PIP      COM : XSUB     COM : ED       COM : ASM      COM
A: DDT      COM : LOAD     COM : STAT     COM : DUMP     COM
A: SUBMIT   COM : PRINT    COM : KYBDTEST COM : FORMAT2  COM
A: CRUN23   COM : FORMAT1  COM : GPIBEXB0 COM : LARECALL COM
A: UC2      COM : LASAVE   COM : LADISA   COM : CM2      COM
A: LA       COM : RAMTEST  COM : SAVREC   COM : CRUN2    COM
A: CBAS     COM : XREF.    COM : GPIBPSB0 MAC : SAVRECB0 MAC
A: GPIBPSB0 REL : GPIBEXB0 REL : SAVRECB0 REL : SAVREC   ASM
A: GPIBEX   INT : GPIBEXB0 BAS : LADISCB0 BAS : GPIBEX   BAS
A: GPIB80   BAS : GPIB     BAS : LADISC   BAS : RS232EX  BAS
A: RS232EX  001 : RS232EX  002 : D6800         : D6B000
A: D9085        : RS232EX  INT : DZ80          : D6809E
A: D488         : D8080        : D8086         : READ     ME
A: UC2      LST : TEST2
A>
```

Figure 11-1. (Sample Only -- Your Directory Will Probably Differ)

The A identifies the disk drive in use. If the dual-disk expansion capabilities are used, a B or C is displayed.

11.4 STAT

STAT is a transient command used primarily to determine how much DISK MEMORY is remaining, or the size of a particular file. Type:

```
STAT (RETURN)
```

The above command will display the remaining disk memory.

```
STAT
A: R/W, Space: 208k

A>
```

Figure 11-2. **The response to a request for space status on the disk.**

Next, type:

STAT RAMTEST.COM $S (RETURN)

```
STAT RAMTEST.COM$S

Recs  Bytes  Ext Acc
   8     4k    1 R/W A:RAMTEST.COM
Bytes Remaining On A: 208k

A
```

Figure 11-3. Using the "STAT" command to determine the size of a file.

This command will display the size of any file using the format: STAT FILENAME.EXT $S. Select another file from your directory and try this command again.

NOTE: You must enter all commands **exactly** as shown with all spaces and characters specified; otherwise the NPC-864MSTWC will respond with a **File Not Found** or other error message.

11.5 ED

ED is a simple implementation of a text editor, used for the creation of files. These files can be text, or they can be a high-level-language program that will later be compiled.

ED has its own set of commands that will only operate after ED has been executed. Those commands allow you to create the text, edit it, store it on disk, and retrieve it from disk.

For this example, only a small portion of those commands will be used. Therefore, it is IMPERATIVE THAT YOU FOLLOW THIS EXAMPLE PRECISELY. Otherwise, you may get into a situation in which this example will not help you recover.

NOTES: 1. If you get into trouble, press **RESET** and ESC and start again.

2. Be certain that the **CAPS LOCK** key is locked in the down position.

Type:

ED TESTFILE.TXT (RETURN)

If this file does not already exist, ED will return with a prompt:

```
NEW FILE
:*
```

11.5.1 INSERT

Next, we must prepare to INSERT text into our file, using the **I** command. Type:

I (RETURN)

ED is now ready to accept text into line 1:

```
1:
```

Begin typing the following text, ending each line with the **RETURN** key. (It is suggested that each line be no more than 80 characters to maintain readability.) **ED** will provide a new line number each time you press **RETURN.**

```
1:  THE NPC-864MSTWC REPRESENTS A NEW TREND IN THE
    TEST AND MEASUREMENT INDUSTRY.

2:  THE INTERNAL COMPUTING POWER OF THE
    MICROPROCESSOR IS NOW AVAILABLE TO THE USER.

3:  TASKS SUCH AS AUTOMATIC TESTING, POST-
    PROCESSING, AND TEST FUNCTION EXPANSION ARE
    EASILY IMPLEMENTED.
```

To end the text insertion mode, simply press **CTRL** and **Z** simultaneously. Then press **RETURN.**

To end this session with **ED,**

Type:

E (RETURN)

The system will now store this text file on the disk. When it returns with the system prompt, **A** , you may use **DIR** to see your new file in the directory. Notice that the system also creates a backup file, TESTFILE.BAK. You can use **STAT** to examine the file size if desired.

11.6 TYPE

TYPE is a built-in command used for quick and easy examination of file contents. When executed, it will display the file exactly as it is stored on the disk.

Type:

TYPE TESTFILE.TXT (RETURN)

If you are examining a large file, you may want to stop the text before it scrolls off the CRT. Simultaneously press **CTRL** and **S** to stop scrolling; press any key to continue scrolling.

11.7 REN

REN will rename an existing file. It will not duplicate the file under a new name, merely change the old name to the new one:

Type:

REN NEWNAME.DOC=TESTFILE.TXT (RETURN)

S=LASAVE
R=LARECALL

As a practical example of **REN**, execute the following commands:

REN S.COM=LASAVE.COM
REN R.COM-LARECALL.COM

Therefore, when using the disk to save and recall logic analyzer tests, the **REN** command allows you to reduce your typing by replacing **LASAVE** with **S** and **LARECALL** with **R.**

DIR will allow you to verify that each file name has been changed.

11.8 ERA

ERA will erase the specified file, FOREVER. Be certain that you specify the correct file. There is no way to recover erased files.

Type:

ERA NEWNAME.DOC (RETURN)
ERA TESTFILE.BAK (RETURN)

11.9 FORMAT 1 AND FORMAT 2

FORMAT 1 and FORMAT 2 are special transient commands supplied by Nicolet Paratronics. Since SYSGEN is not supplied with this system, **FORMAT 1 and FORMAT 2** are used to format a new diskette (or reformat a used one) in preparation for use.*

Type:

FORMAT 2 (RETURN)

```
FORMAT2

FORMATTING PROGRAM FOR NPC 800 SERIES
VERSION 1.0 REV:A FOR DUAL SIDED DOUBLE DENSITY

WRITE ENABLED DISK READY TO FORMAT ON DRIVE B? (Y/N)
```

Figure 11-4. FORMAT 2 is used to format a new disk for the NPC-800.

If desired, insert a "Write Enabled" blank diskette.

Type:

Y (RETURN)

The disk drive will turn on and begin formatting the diskette.

***NOTE 1:** Both **FORMAT** commands will erase **all** programs listed in the directory on your diskette.

***NOTE 2:** Use **FORMAT 2** for the NPC-800 integral disk drives. If you are using external drives which are single-sided, then use **FORMAT 1.**

11.10 ASM

ASM is the transient command which provides the ability to write an assembly language program for the 8080 or 8085. The following example illustrates the mechanics of writing a simple assembly language program using **ED**, assembling the program using **ASM**, converting the program to an executable file using **LOAD**, and finally, executing the program. For detailed explanation of this procedure, refer to the CP/M Software Documentation Manual.

The first step in writing a program is to define the task to be performed. This example will simply display a message on the NPC-864MSTWC CRT. The next step is to create a file, using ED, with **MSSGDISP** as the main file name and **.ASM** as the file name extender. A sample file is shown in Figure 11-5.

```
;*************************************************************
;*THIS IS A TEST PROGRAM TO ILLUSTRATE THE ASSEMBLER.        *
;*************************************************************
        ORG     100H
RDBTEST:  LXI   B,DSTART        ;LD START ADRS

        LXI     H,0F100H        ;LD OUTPUT ADRS

START:  LDAX            B               ;LD DATA TO ACCUM.
        CPI     '$'             ;IS DATA BYTE END OF STRING ?
        JZ      EXIT            ;YES JUMP TO END & EXIT PROG.
        MOV     M,A             ;MOV DATA BYTE TO RAM MEMORY.
        INX     H               ;INC DATA ADRS.
        INX     B               ;INC OUTPUT ADRS.
        JMP     START           ;GO BACK & LD NEXT DATA BYTE.
EXIT:   RET                     ;FINISH.
DSTART: DB      'THIS IS AN EXAMPLE OF THE ASSEMBLER       $'
        END

A>
```

Figure 11-5. Sample source file created by ED.

.PRN FILE

After the program is written and stored on the diskette, it must be assembled. Typing **ASM MSSGDISP** will cause the transient program **ASM** to be loaded. **ASM** will then load MSSGDISP.ASM and create two new files, **MSSGDISP.PRN** and **MSSGDISP.HEX**. The **.PRN** file is the one to be used when printing the source file. See Figure 11-6.

```
                ;*************************************************************
*               ;*THIS IS A TEST PROGRAM TO ILLUSTRATE THE ASSEMBLER.
*               ;*************************************************************
*
 0100                   ORG     100H
 0100 011301    RDBTEST:  LXI   B,DSTART        ;LD START ADRS

 0103 2100F1            LXI     H,0F100H        ;LD OUTPUT ADRS

 0106 0A        START:  LDAX            B               ;LD DATA TO ACCUM.
 0107 FE24              CPI     '$'             ;IS DATA BYTE END OF STRING ?
 0109 CA1201            JZ      EXIT            ;YES JUMP TO END & EXIT PROG
 010C 77                MOV     M,A             ;MOV DATA BYTE TO RAM MEMORY.
 010D 23                INX     H               ;INC DATA ADRS.
 010E 03                INX     B               ;INC OUTPUT ADRS.
 010F C30601            JMP     START           ;GO BACK & LD NEXT DATA BYTE.
 0112 C9        EXIT:   RET                     ;FINISH.
 0113 544849532049START: DB      'THIS IS AN EXAMPLE OF THE ASSEMBLER       $'
 013E                   END

A>
```

Figure 11-6. Sample .PRN file created by ASM.

.HEX FILE

The **.HEX** file shown in Figure 11-7 will be used to create the executable file by using the transient program **LOAD.** Typing **LOAD MSSGDISP** will then load **MSSGDISP.HEX** and create the file **MSSGDISP.COM.**

```
A>TYPE MSSGDISP.HEX
:100100000113012100F10AFE24CA120177230C35F
:10011000601C954484953204953204E4E204558AF
:1001200041 4D504C45204F4620544345204153A3
:0E013000454D424C455220202020202020202406
:00000000000

A>
```

Figure 11-7. Sample .HEX file created by ASM

We now have the file **MSSGDISP.COM** available to be executed.

Type:

MSSGDISP (RETURN)

EXECUTE

The NPC-864MSTWC will now display the message "THIS IS AN EXAMPLE OF THE ASSEMBLER" near the **top** of the CRT.

Using **ED** and the steps illustrated above, you can change the original file **MSSGDISP.ASM,** or create your own new program.

11.11 SUBMIT

The **SUBMIT** utility is a program which allows the user to automatically--and sequentially--execute a series of CP/M command files.

To use this feature of CP/M, you simply create a file, using **ED,** that contains a sequential list of the CP/M command files to be executed. Then type:

A SUBMIT FILENAME

CP/M will load **SUBMIT** which in turn causes all the lines from FILENAME to be sequentially read and executed. When finished, the prompt A appears, indicating that the NPC-864MSTWC is ready for the next command from the keyboard.

EXECUTING CP/M COMMANDS

The following example demonstrates how to use **SUBMIT** to automatically execute several of the CP/M commands discussed previously. In this example, the filename will be **DEMOFILE.** Simply follow the listing in Figure 11-8. (Remember to type **CTRL Z** at line 7 to terminate command entry.)*

```
A>ED DEMOFILE.SUB

NEW FILE
     : *I
     1:  DIR
     2:  ERA *.BAK
     3:  STAT *.COM  $S
     4:  DIR
     5:  ;
     6:  ;THIS COMPLETES DEMOFILE.
     7:
      : *E

A>
```

Figure 11-8. Example of SUBMIT utility.

To execute, type:

A SUBMIT DEMOFILE (RETURN)

At this point, CP/M will load the **SUBMIT** utility and sequentially execute the commands and text in **DEMOFILE** as follows:

1. **DIR**	Display the directory of the diskette, including back-up files (if any).
2. **ERA *.BAK**	Erase all backup files.

***NOTE:** If necessary, see the CP/M Software Documentation Manual for the editing procedures required to correct program entry errors.

---

3. **STAT *.COM $S**	Display the statistics of all **.COM** files.
4. **DIR**	Display the updated directory (without back-up files.).
5. **;**	(Blank line for spacing.)
6. **;THIS COMPLETES DEMOFILE**	(Comment.)

EXECUTING ANALYZER TESTS

One of the most powerful advantages of combining logic analysis with CP/M is the simplicity in which multiple tests--including user prompts--can be automated. In the following example, three separate analyzer tests and corresponding test instructions are created, stored, and executed using **SUBMIT**.

STATE TEST

1. Press **RESET** to access the analyzer operating system. Call the 48 CHANNEL STATE menu and enter **0040** as the trigger word. (Leave all other menu parameters unchanged.)

2. Connect the **A** state probe to the **A** side of the Logic Analyzer Test Card supplied with the NPC-864MSTWC. (See Section 6.1 for a description of the test card.) The state probe switches should be set to **TTL** and **TRUE**.

3. Press **COLLECT** to take and display a data collection. Save the data in the auxiliary memory by pressing **S.**

4. Press the **CONFIG** followed by the **ESC** key to call the CP/M operating system. When the **A** prompt appears, type:

   LASAVE STATE (RETURN)

   to save the first test under the arbitrary file name: **STATE.*** When the test is saved, the CONFIGURATION LIST will automatically appear.

TIMING TEST

1. Call the 16 CHANNEL TIMING menu. Enter in a sample clock of 100 uS and a trigger word of **XXXXXXXX 00000000.** (X=don't care.) Also set PRETRIG to **00%**.

2. Connect the **B** timing probe to the **B** side of the test card. Then press **COLLECT** to take and display a data collection. Use X20 magnification. Save the data in the auxiliary memory by pressing **S.**

3. Call the CONFIGURATION LIST and press **ESC** as before.

   Type:

   LASAVE TIMING (RETURN)

   to save the second test under the arbitrary file name: **TIMING.**

***NOTE:** If you've renamed **LASAVE** as S, type **S STATE (RETURN)** to save data.

WAVEFORM TEST (OPTIONAL WAVEFORM BOARD MUST BE INSTALLED)*

1. Call the **WAVEFORM RECORDER** menu. Set the ATTENUATOR to 1V/DIV and the Dynamic Range (-)1.6 volts to (+)6.4 volts. (See Figure 6-17, if necessary.)

2. Press the S2 key to access the display mode so you can press the C key to call the clock field in the timing menu. Set this clock to 1 uS. Step down to the trigger LINKAGE field and select W for single-shot operation.

3. Connect the Model 90 probe to the WAVEFORM BNC at the rear of the NPC-864MSTWC. (Make sure it is not connected to the CTSA BNC.) With X10 selected, place the probe tip at the **WF** test point on the test card and press **COLLECT.** (It is not necessary to connect the probe ground wire.) Select X1 magnification when the waveform is displayed. Save the data in auxiliary memory by pressing the S key.

4. Call the CONFIGURATION LIST and press ESC as before.

   Type:

   LASAVE WAVE (RETURN)

   to save the third test under the arbitrary file name: WAVE.

DIRECTORY

Press ESC and type DIR **(RETURN)** to verify that you have STATE, TIMING, and WAVE files on the diskette.

OPERATOR PROMPTS

Using the **ED** utility, you can create a message that will prompt the user for each test. However, in order to keep the message on the screen until the user is ready to continue, a **PAUSE** program is required.

AUTOMATIC TESTING

The SUBMIT program for controlling the logic analyzer will be called **AUTOTEST.** To incorporate prompting messages prior to each test, follow the procedure described below:

PAUSE

The **PAUSE** program in Figure 11-9 is written in assembly language.

```
A>ED PAUSE.ASM
NEW FILE
     : *I
    1:          ORG     100H
    2:          MVI     C,1
    3:          CALL    5
    4:          RET
    5:
     : *E
A>ASM PAUSE.AAX
```

Figure 11.9 PAUSE program.

***NOTE:** If your NPC-864MSTWC does not have this option, continue with the procedure and ignore all references to waveform.

When typing the program in Figure 11-9, press the **TAB** key to achieve the spacing shown. Also, don't forget to type **CTRL Z** at line 5 to exit program entry. The command **ASM PAUSE.AAX** initiates program assembly.

After program assembly,

type:

A LOAD PAUSE

Check the directory to verify your **PAUSE** program.

AUTOTEST

The program in Figure 11-10 combines analyzer tests, prompting messages, and the **PAUSE** program.*.

```
A>ED AUTOTEST.SUB

NEW FILE
     : *I
    1:  ;
    2:  ; TO THE OPERATOR:  YOU'RE GOING TO PERFORM 3 TESTS.
    3:  ; IT'S IMPORTANT THAT YOU FOLLOW THE INSTRUCTIONS CAREFULLY.
    4:  ;
    5:  ; STATE TEST:  AFTER READING THE INSTRUCTIONS BELOW, PRESS RETURN
    6:  ;              WHEN THE CURSOR FLASHES.  THIS WILL CALL THE STATE TEST.
    7:  ;
    8:  ;  A. CONNECT THE A STATE PROBE TO THE A SIDE OF THE TEST CARD.
    9:  ;  B. WHEN THE CONFIGURATION LIST APPEARS, PRESS THE COLLECT KEY.
   10:  ;  C. AFTER THE TEST IS COMPLETE, PRESS THE CONFIG KEY FOLLOWED BY THE
   11:  ;     ESC KEY TO RECEIVE INSTRUCTIONS FOR THE NEXT TEST.
   12:  ;
   13:  ; REMEMBER, PRESS RETURN WHEN THE CURSOR FLASHES.
   14:  PAUSE
   15:  LARECALL STATE
   16:  ;
   17:  ; TIMING TEST
   18:  ;
   19:  ;  A. CONNECT THE B TIMING PROBE TO THE B SIDE OF THE TEST CARD.
   20:  ;  B. WHEN THE CONFIGURATION LIST APPEARS, PRESS THE COLLECT KEY.
   21:  ;  C. AFTER THE TEST IS COMPLETE, PRESS THE CONFIG KEY FOLLOWED BY THE
   22:  ;     ESC KEY TO RECEIVE INSTRUCTIONS FOR THE NEXT TEST.
   23:  ;
   24:  PAUSE
   25:  LARECALL TIMING
   26:  ;
   27:  ; WAVEFORM TEST (OPTIONAL)
   28:  ;
   29:  ;  A. CONNECT THE SCOPE PROBE TO THE WF TESTPOINT ON THE TEST CARD.
   30:  ;  B. AFTER THE CONFIGURATION LIST APPEARS, PRESS THE COLLECT KEY.
   31:  ;  C. THIS COMPLETES THE TEST SERIES.
   32:  PAUSE
   33:  LARECALL WAVE
   34:
     : *E
```

Figure 11-10. AUTOTEST program.

***NOTE:** If necessary, see the CP/M Software Documentation Manual for the editing procedures required to correct program entry errors.

Don't forget **CTRL Z** on line 34. Also, replace **LARECALL** by R if you've previously renamed this command.

After entering this program, you can execute it by typing:

SUBMIT AUTOTEST (RET)

and following the instructions. Note how the NPC-864MSTWC executes each line exactly as it was originally typed in. The user is encouraged to use this simple example as a model for more comprehensive automatic tests.

NOTE: If automatic tests **without** operator intervention are required, the GPIB controller capability of the NPC-864MSTWC can be used. See Section 13.0.

12.0 INPUT/OUTPUT INTERFACE PORTS

12.1 PROBE CONNECTIONS

The primary inputs to the logic analysis functions of the NPC-800 are the probe connectors located on the left side of the instrument. See Figure 12-1. These ports are bidirectional, allowing the user to not only acquire data to be saved in the high-speed RAM of the analyzer, but also to output stimulus or data to his system under test via a user-supplied interface. (The probes themselves are not bidirectional.)

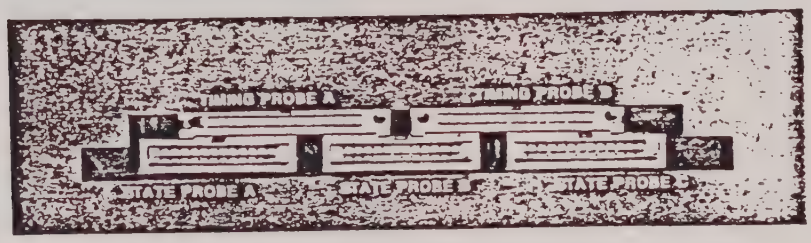

Figure 12-1. Probe connections. (NPC-864MSTWC shown.)

12.2 EXTERNAL VIDEO OUT

This rear-panel BNC connector, shown in Figure 12-2, allows the NPC-800 user to display video information from the CRT on an external monitor. It can also be used to drive a video printer for hard copy documentation of menus and associated data. The output of this connector is standard composite video and its impedance is 75 ohms.

NOTE: The NPC-800 uses halflight reverse video in some menu fields. Some video printers cannot reproduce these fields. In order to use these printers, you must short out the 680-ohm voltage divider (R5) on the top left portion of the Processor Board (just below the video connector). Use a shorting wire with miniature ball clips on both ends, or install a SPST switch. Remove the short when printing displayed data.

12.3 RS-232C SERIAL* INTERFACE PORT (NPC-864MSTWC ONLY)

As shown in Figure 12-2, the NPC-864MSTWC uses a standard EIA 25-Pin connector to provide a bidirectional interface to RS-232C compatible devices such as printers, PROM programmers, emulators, etc. The interface connection and internal switch settings are described below.

NOTE: An optional RS-232C software package for outputting text and graphics to an Epson (or equivalent) printer is available. Contact your local NPC sales office or the factory for details.

---

*Only the NPC-864MSTC includes the Serial I/O.

12.3.1 INTERFACE CONNECTIONS

The connection utilizes standard EIA levels of ± 12 V amplitude (positive true logic) and are described in the following list. Unlisted pin numbers are not used by the NPC-864MSTWC.

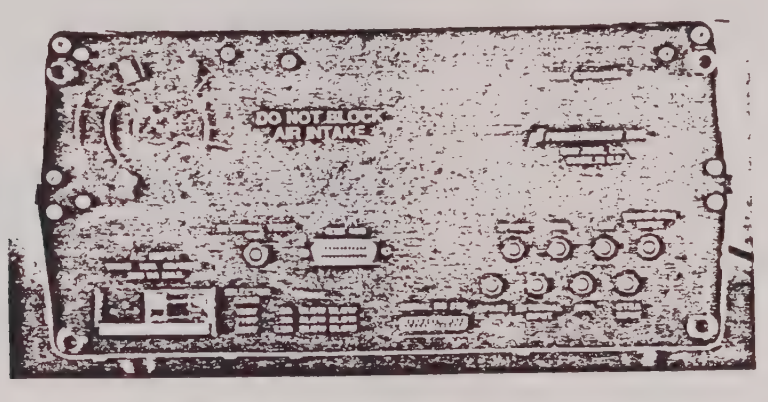

Figure 12-2. NPC-864MSTWC Rear Panel connectors.

RS-232C
PIN DEFINITIONS

PIN 1 Chassis and logic **Ground.**

PIN 2 **Serial In.** (Note: The Disk/RAM Controller (DRC) board can be "strapped" to configure this pin as **Serial Out.**)

PIN 3 **Serial Out.** (Note: The Disk/RAM Controller (DRC) board can be "strapped" to configure this pin as **Serial In.**)

PIN 4 **Return to Send (RTS).** Programmable. Upon power-on reset, RTS is normally "ON."

PIN 5 **Clear to Send (CTS).** If data is transmitted to the NPC-864MSTWC, this pin must be pulled up so that if disconnected, it is normally high (ON).

PIN 6 **Data Set Ready (DSR).** Status bit DSR is readable, if desired, and is pulled up so it is normally high (ON).

PIN 7 **Logic Ground.**

PIN 8 **Data Carrier Detect (DCD).** Status bit DCD is readable, if desired, and is pulled up so it is normally high (ON).

PIN 20 **Data Terminal Ready (DTR).** Programmable DTR is driven by software and is normally (ON).

All other pins are disconnected. "Pulled high" means the pin is tied to +15V through a resistor.

12.3.2 INTERFACE CONFIGURATION

The RS-232C interface is implemented using a Rockwell (Synertek) 6551A chip. This chip is user-programmable to suit desired interface conditions.

The NPC-864MSTWC has been designed to interface to other RS-232C compatible equipment. Reference to the 6551A chip manufacturer's data manual (Rockwell/Synertek) is recommended.

CONTROL REGISTER COMMAND REGISTER

The control register selects the mode of the chip with regard to word length, number of stop bits and clock controls. The command register is used to control specific transmit/receive functions. These are programmed automatically when power is initially applied, and are set up in accordance to the dip switch located on the Processor Board in the card cage inside the NPC-864MSTWC as shown in Figure 12-3. See Figure 12-4 for dip switch settings.

NOTE: The default condition for **CHARACTER LENGTH** is 8 bits with 1 **STOP** bit. Parity is disabled.

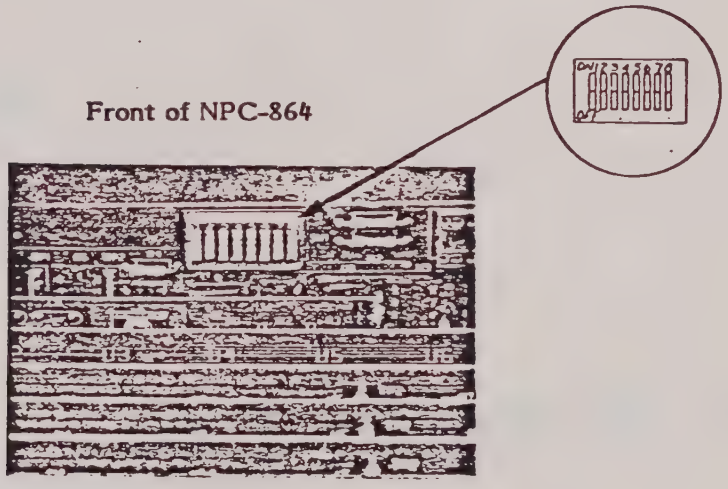

Figure 12-3. Dip Switch location on Processor Board.

RS-232C SET-UP

The RS-232C interface is set up using the I/O Configuration Menu. See Section 5.10.

12.4 SWITCH SETTINGS

S8 S7 S6 S5 S4 S3 S2 S1 SWITCH: 0 = ON 1 = OFF

RS-232 0 = SLAVE
1 = MASTER

GPIB 0 = DEVICE
1 = CONTROLLER

SEE 12.4.1 BELOW

BUSY POLARITY (INVERTED/NON)

NOT USED

50/60 Hz
OFF 50 Hz
ON 60 Hz

Figure 12-4. Processor Board DIP Switch Settings (NPC-864MSTWC).

12.4.1 DEFAULT BAUD RATE

The DIP switch settings for the power-on default baud rate are as follows:

S4	S3	BAUD RATE
0	0	300
0	1	1200
1	0	4800
1	1	9600

12.5 IEEE-488 PARALLEL INTERFACE PORT

See Sections 13.0 and 14.0 for a description of the NPC-864MSTWC as a CONTROLLER and DEVICE, and Section 14.0 for a description of the NPC-848S, NPC-816T, or NPC-864ST as a DEVICE. The Processor Board DIP Switch settings for NPC-848S, NPC-816T, or NPC-864ST LISTENER/TALKER operation are shown below:

GPIB DEVICE ADDR

ON = 0 OFF = 1

(ADDR 31 DEFAULTS to 30)

A0 = SWITCH 1
A1 = SWITCH 2
A2 = SWITCH 3
A3 = SWITCH 4
A4 = SWITCH 5

SWITCH 8

ON = 60 Hz
OFF = 50 Hz

TERMINATION SEQUENCE:

ALWAYS ON EOI

SW6	SW7	
ON	ON	EOI ONLY
ON	OFF	CR
OFF	ON	LF
OFF	OFF	CR,LF

13.0 IEEE-488 INTERFACE CONTROLLER

The requirement for the automation of test and measurement equipment using the IEEE-488 bus has grown in recent years. IEEE-488 applications range from research projects, which require extremely complex measurements, to production test which requires that the same test be performed repetitively without deviation from the prescribed process.

The IEEE-488 General Purpose Interface Bus (or GPIB) offers the user the flexibility to configure a test system to include most types of test instruments. Due to the standardization of the interface, instruments from different manufacturers can readily be connected using a GPIB Controller.

The NPC-864MSTWC can be used as the CONTROLLER in a GPIB environment. It provides a set of commands which have been optimized for ease of use, but still retain a great deal of flexibility. The instrument can also function as a LISTENER/TALKER through resident software in its ROM-based, Analyzer Operating System.

The command set has been designed such that it can be accessed from any application program: It has not been restricted to a specific language, such as CBASIC. Therefore, GPIB control functions can be available from a number of CP/M-compatible higher-order languages. However, CBASIC is standard and a new software interface would have to be written to accommodate another language. See Section 13.7 and contact Nicolet Paratronics for further information.

13.1 COMMAND SET SUMMARY

ABORT GPIB — This command clears the interface. All transactions presently taking place on the bus will stop and the interface is initialized.

RESET — This command performs the reset function on each instrument--individually or universally.

REMOTE — This command enables one or all instruments to respond to the controller's commands.

LOCAL — This command is the opposite of **REMOTE**, returning one or all instruments to local, front-panel control.

TRIGGER — This command is used after an instrument has been set up to make a data collection. Typically, several instruments are set up in sequence; then all are TRIGGERED at the same time to make a data collection.

REQUEST — This command is used to assert the Request For Service line, SRQ. Normally, **REQUEST** will be used when the NPC-864MSTWC is acting as a LISTENER/TALKER on the bus.

OUTPUT — This is the command used to send data to each instrument. The data sent is usually a string of characters interpreted by the instrument as set-up instructions.

ENTER This command is the opposite of **OUTPUT**. It instructs the instrument to send data to the controller. (The data is usually the result of a specific test.)

STATUS This command is used to serially request the status of each instrument to determine whether it has completed the last instruction.

SET TIMEOUT This command is used to change the maximum time to wait for a response on the bus.

LOCAL LOCKOUT The **LOCAL LOCKOUT** command is used by the controller to lock all devices under remote control and disable front-panel input. The **LOCAL ALL** command is used to defeat **LOCAL LOCKOUT**.

CONFIGURE This command is used by the NPC-864MSTWC to set up data transmission between devices other than the NPC-864MSTWC.

EOI STATUS This command is used to identify the end of a data transmission between devices. It is used after a **CONFIGURE** command.

SENDBUS This is a special command used to tailor controller output for custom applications.

TERM SEQ This command gives the user flexibility in specifying data termination sequences when used with subsequent **OUTPUT** or **ENTER** commands.

The above command set provides the capability to perform most of the common functions required in a GPIB test system. The IEEE-488 standard interface connector, located on the back panel of the NPC-864MSTWC, allows easy interface to the instruments being controlled. See Figure 12-2.

3.2 REFERENCE DOCUMENTS

The following documents should be referred to if necessary to elaborate on the discussions in the following sections:

CBASIC Language Manual
TMS9914 GPIB Adaptor Data Manual
ANSI/IEEE Std. 488-1978

3.3 ABBREVIATIONS

ATN	Attention
DAB	Data Byte
DCL	Device Clear
GET	Group Execute Trigger
GTL	Go to Local
IFC	Interface Clear
LA	Listen Address
LAG	Listen Address Group (See Note 1)
MA	My Address
MLA	My Listen Address
MTA	My Talk Address
SCG	Secondary Command Group
SDC	Selected Device Clear
SPD	Serial Poll Disable
SPE	Serial Poll Enable
SRQ	Service Request
STB	Status Byte
TA	Talk Address
TAG	Talk Address Group (See Note 2)
TLC	Talker/Listener/Controller
UNL	Unlisten
UNT	Untalk

Note 1: LAG is defined as LA SCG LA SCG .

Note 2: TAG is defined as TA SCG

Where XXX indicates to duplicate "XXX" 0 or more times

13.4 GENERAL DISCUSSION

The GPIB command package allows the NPC-864MSTWC to be used as a GPIB system controller, or as a device on a bus with a different controller.

The NPC-864MSTWC utilizes an 8085 microprocessor with a CP/M operating system, and a TMS9914 GPIB adaptor chip. The GPIB command package uses the TMS9914 to control and interface to the bus. The commands can be used directly from an 8085 assembler program, or from a higher level language such as CBASIC. (The software interface to the commands is very flexible, allowing easy implementation from a variety of other languages.)

As a system controller, the NPC-864MSTWC can transfer data to and from devices, respond to a service request, and send these GPIB commands: Remote/Local Changes, Device Clear, Selected Device Clear, Group Execute Trigger and Serial Poll. Commands and data output can be sent to any combination of bus listeners. Complete secondary addressing capability is also available. As a bus device, the NPC-864MSTWC can request service, respond to a serial poll and transfer data across the bus when addressed by the controller. A bus status command can be executed at any time to get the complete NPC-864MSTWC interface and GPIB status.

13.5 DETAILED GPIB COMMAND DESCRIPTIONS

This section provides a description of each of the GPIB commands including command references.

The I/O Menu is used to enable the interface, set the bus address--and optionally--to define the data termination sequence. See Section 5.10.

ABORT GPIB OR INIT GPIB

This command will **ABORT** any pending bus transactions, put all devices in remote and assert the NPC-864MSTWC as the active controller. Also, all necessary initialization for proper bus functioning is performed. If the TALKER/LISTENER/CONTROLLER (TLC) mask specifies that the NPC-864MSTWC is not the system controller, only initialization in the NPC-864MSTWC will be performed; the bus configuration remains unchanged.

Sequence

1) Reset the TMS9914 bus controller chip
2) Save MAX-TIMEOUT in parameter area
*3) Set IFC
*4) Wait 100 uS
*5) Set IFC
*6) Set REN

***Note:** These steps are performed only if the TLC mask = XX1

RESET

The **RESET** command will place a device (or devices) into a known initial state. Two different **RESETS** are implemented. If an address list is specified, an SDC command is sent to each device in the list. Otherwise, a DCL command is sent to all devices. Whether a device implements a DCL or SDC, and the actual effects of the command, depends on the particular instrument used. Only the active controller can issue a **RESET**.

A. Sequence For No Address List

1) Set ATN
2) Send DCL

B. Sequence For Address Specified

1) Set ATN
2) Send MTA
3) Send UNL
4) Send LAG
5) Send SDC

REMOTE

The **REMOTE** command is sent by the active controller to place one or more devices under GPIB control. It can be issued to all devices or to any specified device or group of devices. Normally, the **REMOTE** to all devices is not necessary, as it is also executed during the **ABORT** GPIB command. A device (or devices) can be removed from the **REMOTE** state with the **LOCAL** command, then later toggled back to **REMOTE**.

A. Sequence For REMOTE-All Devices

1) Set REN

B. Sequence For REMOTE Device

1) Set REN
2) Set ATN
3) Send MTA
4) Send UNL
5) Send LAG

NOTE: The actual state of a device on the bus when in **REMOTE** is device dependent.

LOCAL

The **LOCAL** command is used to remove a device from GPIB control and return it to its "normal" front-panel operation. This command may be issued to all devices or to any subset of devices. The **LOCAL** command has no effect if a **LOCAL LOCKOUT** has been issued by a controller and not cleared.

Normally the **LOCAL** command is sent by the active controller. Two special cases are permitted when the NPC-864MSTWC is not the active controller. If no address is specified, the NPC-864MSTWC will be set to the **LOCAL** state independent of the active controller. If the NPC-864MSTWC is not the active controller and its own address is specified, it will "LOCK" itself in the **LOCAL** state, so that the active controller will have no access. Sending a **LOCAL** command again with no address will "UNLOCK" the NPC-864MSTWC.

A. Sequence For All Devices

1) Set $\overline{\text{REN}}$

B. Sequence For A Device

1) Set ATN
2) Send MTA
3) Send UNL
4) Send LAG
5) Send GTL

TRIGGER

The **TRIGGER** command is sent by the active controller to initiate a device function (e.g., take DMM reading, send burst of pulses from pulse generator, etc.). The **TRIGGER** command is sent only to those addresses specified. Note that the **TRIGGER** command is sent to all devices simultaneously; however, internal device delays should be considered for proper operation.

Sequence For **TRIGGER** Device(s)

1) Set ATN
2) Send MTA
3) Send UNL
4) Send LAG
5) Send GET

REQUEST

The **REQUEST** command is used to set the status byte that the active controller will read from **MA** during a serial poll. If BIT 6 of the status byte is set, a service request will be sent to the controller. **REQUEST** has no function when in the active controller state, but the status will be set when this state is exited.

Sequence

1) Set STB
*2) Set SRQ
*3) After active controller executes A serial poll, set $\overline{\text{SRQ}}$.

*Only when BIT 6 = 1

OUTPUT

When in the active controller state, the **OUTPUT** command will transfer DATA to all devices specified in the address list. When in the TALKER-only state, data is transferred to any devices set to listen by the active controller. In this case, the NPC-864MSTWC is not the initiating device, and will only output the data after it is requested. Data string length is Ø to 65535 characters (Ø to 255 from CBASIC).

A. Sequence

1) Set ATN
2) Send MTA
3) Send UNL
4) Send LAG
5) Set $\overline{\text{ATN}}$
6) Send DAB
7) Repeat 6 for additional characters
8) Send TERMINATION SEQUENCE

B. Sequence For TALKER-Only

1) Send DAB
2) Repeat 1 for additional characters
3) Send TERMINATION SEQUENCE

ENTER

When in the active controller state, the **ENTER** command will transfer data from the device specified to the NPC-864MSTWC. When in the LISTENER-only state, data is transferred from the TALKER to the NPC-864MSTWC. Data string length is Ø to 65535 characters (Ø to 255 from CBASIC).

Sequence

*1) set ATN
*2) Send UNL
*3) Send MLA
*4) Send TAG
*5) Set $\overline{\text{ATN}}$
6) Enter DAB
7) Repeat Step 6 until the TERMINATION SEQUENCE is satisfied.
*8) Set ATN
*9) Send UNT

Notes: *Used only in the active controller mode.

If in the LISTENER-only state, it is up to the user to first determine that data are being transferred to the NPC-864MSTWC, using the **STATUS** command.

STATUS

There are three different functions of the **STATUS** command. The first can be executed at any time using the address = "B" (controller or noncontroller). This command will return MA for the NPC-864MSTWC and the TALKER/LISTENER/CONTROLLER status (i.e., active, idle, or not allowed for each function). Also, the occurrence of any of the following bus commands will be reported:

GET
DCL
SDC
MA
UNIDENTIFIED COMMAND
HANDSHAKE ERROR
IFC
SRQ

The second form of the **STATUS** command is implemented by specifying the address of one GPIB device. This will return the device **STATUS BYTE**, which occurs after a **SERIAL POLL.**

The third form of the **STATUS** command is implemented by not specifying an address. This will cause a serial poll of all bus addresses. The return data will be the status of each bus address (i.e., active, inactive, or service required).

A. Sequence For Address

1) Set ATN
2) Send UNL
3) Send MLA
4) Send TA
5) Send SPE
6) Set $\overline{\text{ATN}}$
7) Receive STB
8) Set ATN
9) Send SPD
10) Send UNT

B. Sequence For "No" Addresses

1) Set ATN
2) Send UNL
3) Send MLA
4) Send SPE
5) Send TA(1)
6) Set $\overline{\text{ATN}}$
7) Receive DAB
8) Set ATN
9) Repeat 5 thru 8 for TA (2) thru TA (30)
10) Send SPD
11) Send UNT

SET TIMEOUT

The **SET TIMEOUT** command can be issued at any time to change the maximum time (in msec) to wait for a response on the bus. The **ABORT GPIB** command will reset the max time to a default time specified in the primitives.

LOCAL LOCKOUT

LOCAL LOCKOUT (LLO) is a GPIB universal command, which can be issued by the active controller to lock all devices under GPIB remote control and disable front-panel local control (if any). A **LOCAL ALL** command must be used to defeat the **LOCAL LOCKOUT**.

Sequence

1) Set ATN
2) Send LLO

CONFIGURE

The **CONFIGURE** command can be used when the NPC-864MSTWC is the active controller to set up the GPIB for data transmission between devices other than the NPC-864MSTWC. One TALKER and any number of LISTENERS can be specified. After the bus is configured, ATN is set false to allow the TALKER to begin transmitting data. The **EOI STATUS** command can be used to look for an occurrence of EOI, which signifies that the data transmission has been completed.

Sequence

1) Set ATN
2) Send UNL
3) Send LAG
4) Send TAG
5) Set $\overline{\text{ATN}}$

EOI STATUS

The **EOI STATUS** command is a special-purpose command (designed to be used after a **CONFIGURE**) that indicates the end of data transmission between devices.

SENDBUS

The **SENDBUS** command allows the user to tailor controller output for a special application. Any sequence of universal commands, addressable commands, or data can be specified--up to a maximum of 65535 bytes (255 bytes for CBASIC).

TERM SEQ

The **TERM SEQ** command allows flexible data termination sequences to be used in any subsequent **OUTPUT** or **ENTER** command. Several options are available:

1) Terminate output and enter with CR-LF.
2) Output--Same as 1, but with EOI true for LF.
   Enter--Terminate on EOI.
3) Output--Force EOI on last data byte.
   Enter--Terminate on EOI.
4) Same as 1, but any termination sequence (up to 5 bytes) can be specified in place of CR-LF.
5) Same as 4, but EOI is forced on last byte of specified termination sequence.

13.6 GPIB COMMAND IMPLEMENTATION VIA CBASIC

This section describes how to use each GPIB command from a CBASIC PROGRAM. In order to use the GPIB from CBASIC, the file GPIB.BAS must be inserted ahead of any GPIB command references in a CBASIC PROGRAM before compilation. This can be done using the EDITOR or by using: % INCLUDE GPIB.

This CBASIC directive will include GPIB.BAS in the compilation directly following its placement. This file contains the CBASIC source code which defines the GPIB FUNCTION definitions. Any of these function definitions which are not needed by a user program can be deleted, if necessary, to conserve memory space.

In the heading of the GPIB function definitions are several variables the user may wish to change, they are:

1) Start address of GPIB commands in PROM
2) Start address of 32 byte RAM parameter & stack area

For each GPIB command, a CBASIC statement format is defined. This is the recommended format, and can be modified for a particular application. Any valid CBASIC statement can be used, so long as the function call is intact.

ABORT GPIB OR INIT GPIB

Statement Format (Type on one line):

```
STMT NUMBER     GPIB.RET% = FN.ABORT.GPIB%
                or GPIB.RET% = FN.INIT.GPIB%
```

Parameters: None

Options: None. (However, the effects of the command will depend on whether the NPC-864MSTWC is the system controller.)

Purpose:
1) Initialization
2) Abort pending bus transactions (only when system controller)
3) Take control of bus (only when system controller)

Return Code: GPIB.RET% = 0 NPC is active/system controller
GPIB.RET% = 1 NPC-864MSTWC is device

Notes: The **INIT GPIB** command must be used prior to any other GPIB command in a program to assure proper initialization.

RESET

Statement Format (Type on one line):

STMT NUMBER GPIB.RET% = FN.RESET%(ADDRESS LIST)

Parameters: ADDRESS LIST is an ASCII string which specifies which bus devices are to be RESET. (See Section 13.6.1 for Data Format.)

Options:

1. ADDRESS LIST = "valid Section 13.6.1 format" data
   This will send a selected device CLEAR (SDC) to all bus devices specified.
2. ADDRESS LIST = NULL. This will send a DCL to all bus devices.

Purpose:

1. Send a SDC to each address specified in the ADDRESS LIST or
2. Send a DCL to all devices on GPIB

Return Code: GPIB.RET% will equal 0 if the command executed properly; otherwise one or more error bits will be set as follows:

BIT	
0	NPC-864MSTWC is not the active controller
1	Not used
2	Timeout
3	Invalid ADDRESS LIST format

Notes: The **RESET** command does not reset the GPIB. The actual effect of the command (if any) depends on its implementation in bus devices.

REMOTE

Statement Format (Type on one line):

STMT NUMBER GPIB.RET% = FN.REMOTE%
(ADDRESS LIST)

Parameters: ADDRESS LIST is an ASCII string which specifies which bus devices are to be set to GPIB control. (See Section 13.6.1 for data format.)

Options:

1. ADDRESS LIST = "valid Section 13.6.1 format" data
   Used when the NPC-864MSTWC is the active controller to set specific bus devices back to GPIB bus control after a **LOCAL** command with Option 1 has been executed.
2. ADDRESS LIST = NULL. Used when the NPC-864MSTWC is the active controller to re-assert the REN LINE, after a LOCAL (with Option 2) has been executed.

Purpose: To set the bus or bus devices back to GPIB control after a **LOCAL** command has been executed.

Return Code: GPIB.RET% will equal 0 if the command executed properly, otherwise, one or more error bits will be set, defined as follows:

BIT	
0	NPC-864MSTWC is not the active controller
1	Not used
2	Timeout
3	Invalid ADDRESS LIST format

Notes: A **REMOTE** command with option 2 will not place devices in **REMOTE** if they have been set to **LOCAL** using option 1. They must be set back to remote using the option 1 format.

LOCAL

Statement Format (Type on one line):

```
STMT NUMBER  GPIB.RET% = FN.LOCAL%
             ( ADDRESS LIST )
```

Parameters: ADDRESS LIST is an ASCII string which specifies which bus devices are to be set to **LOCAL** (front panel) operation. (See Section 13.6.1 for data format.)

Options:

1. ADDRESS LIST = "valid Section 13.6.1 format" data. Used when the NPC-864MSTWC is the active controller, command specifies devices to **LOCAL.**
2. ADDRESS LIST = NULL. When the NPC-864MSTWC is the active controller, a DCL is sent to all devices. If the NPC-864MSTWC is not the active controller, only the NPC-864MSTWC will be set to **LOCAL.**
3. ADDRESS LIST = "L" used when the NPC-864MSTWC is not the active controller. This option will lock the NPC-864MSTWC in local until a **LOCAL** command using option 2 is executed.

Purpose: Remove a device (or devices) from GPIB bus control and return it to "front panel" operation.

Return Code: GPIB.RET% will equal Ø if the command executed properly, otherwise one or more error bits will be set, defined as follows:

BIT	ERROR DEFINITION
Ø	Improper controller state
1	Not used
2	Timeout
3	Invalid ADDRESS LIST format

TRIGGER

Statement Format (Type on one line):

STMT NUMBER GPIB.RET% = FN.TRIGGER%
(ADDRESS LIST)

Parameters: ADDRESS LIST is an ASCII string specifying which bus devices are to receive the Group Execute Trigger (GET) command. (See Section 13.6.1 for data format.)

Options: None

Purpose: To send a **GET** command (simultaneously) to all devices specified in the address list.

Return Code: GPIB.RET% will equal Ø if the command executed properly: otherwise one or more error bits will be set as follows:

BIT	
Ø	NPC-864MSTWC is not the active controller
1	Not used
2	Timeout
3	Invalid ADDRESS LIST format

Notes: When using the **TRIGGER** command to trigger multiple devices simultaneously, it is important to consider response times of instruments as it can vary widely (from msec to sec).

REQUEST

Statement Format (Type on one line):

STMT NUMBER GPIB.RET% = FN.REQUEST%
(STATUS)

Parameters: STATUS is an **INTEGER** that will be sent (LSB only) on the GPIB as a response to a serial poll by the active controller.

Options: Bit 6 of STATUS is used to request service from the active controller. If it is set, an SRQ is generated. The remaining 7 bits can be defined by the user.

Purpose:
1) Load GPIB status byte
2) Optionally generate an SRQ

Return Code: Bit 2 Timeout

Notes:
1) **ABORT.GPIB** will clear the status byte.
2) **RESET** to MA will clear the status byte.
3) **REQUEST** can be executed when the NPC-864MSTWC is the active controller and the status byte will be loaded, but no other action will take place.

OUTPUT

Statement Format (Type on one line):

```
STMT NUMBER  GPIB.RET% = FN.OUTPUT%
                ( ADDRESS LIST , DATA )
```

Parameters: DATA is an ASCII string which is sent to all bus devices that are set to listen. It can be any valid CBASIC string expression (Ø to 255 characters).

ADDRESS LIST is an ASCII string which specifies the bus devices which are to listen to the data. (See Section 13.6.1 for data format.)

Options:

1. ADDRESS LIST = "valid Section 13.6.1 format" data is used when the NPC-864MSTWC is the active controller and specifies the bus LISTENERS.
2. ADDRESS LIST = NULL is used when the NPC-864MSTWC is not the active controller.

Purpose: Transmit ASCII data from the NPC-864MSTWC to other bus devices

Return Code: GPIB.RET% will equal Ø if the command executed properly, otherwise one or more error bits will be set, defined as follows:

BIT	ERROR DEFINITION
Ø	Improper controller state
1	In device mode and not addressed to talk
2	Timeout
3	Invalid ADDRESS LIST format
4	NPC-864MSTWC is not a TALKER

Notes:

1) The TERMINATION SEQUENCE will be transmitted immediately following data to signify end of transmission.

ENTER

Statement Format (Type on one line):

```
STMT NUMBER  DATA$ = FN.ENTER$( ADDRESS )
```

Parameters: DATA is a string variable which will contain the ASCII data entered from a device, after execution.

ADDRESS is an ASCII string which specifies the address of the device which is to talk on the bus. (See Section 13.6.1 for data format.)

Options:

1. ADDRESS LIST = "valid Section 13.6.1 format" data is used when the NPC-864MSTWC is the active controller.
2. ADDRESS LIST = NULL is used when the NPC-864MSTWC is not the active controller or for continuing the entering of long data strings.

Purpose: To transmit data from another device on the GPIB to the NPC-864MSTWC.

Return Code: GPIB.RET% will equal Ø if the command executed properly; otherwise one or more error bits will be set as follows:

BIT	ERROR DEFINITION
Ø	Improper controller state
1	In device mode and not addressed to listen
2	Timeout
3	Invalid (address) format
4	NPC-864MSTWC is not a LISTENER
5	Input data has been truncated

Notes:

1) Data will be entered from the TALKING device until the termination sequence is encountered. However, only the first 255 bytes will be saved in data.

2) To continue entering data when truncated, use the ADDRESS = NULL mode repetitively until data transfer is complete (i.e., GPIB.RET%=0).

STATUS

Statement Format (Type on one line):

STMT NUMBER DATA$ = FN.STATUS$(ADDRESS)

Parameters: DATA is a string variable which will contain the status of the device (or devices) specified by ADDRESS

ADDRESS is an ASCII string which specifies the address of the device whose status is required. (See Section 13.6.1 for data format.)

Options: ADDRESS = "valid Section 13.6.1 format" data will return the STB for the device specified by address.

ADDRESS = NULL will return the status of all bus addressees (i.e., present, not present or service required).

ADDRESS = "B" will return the bus status (i.e., hardware status, NPC-864MSTWC bus address (MA), and TLC mask).

Purpose:

1) Perform serial poll of specific device and return its status byte, or
2) Get configuration status (i.e., what devices are present, who is requesting service) or
3) Get all available NPC-864MSTWC GPIB status

Return Code: GPIB.RET% will equal 0 if the command executed properly; otherwise, one or more error bits will be set as follows:

BIT	ERROR DEFINITION
0	Not active controller
1	Not used
2	Timeout
3	Invalid address format
15-8	Device status byte

BIT	DEFINITION FOR BUS STATUS
0	REN is true
1	IFC is true
2	SRQ is true
3	EOI is true
4	NRFD is true
5	NDAC is true
6	DAV is true
7	ATN is true
8	IFC has occurred
9	SRQ has occurred
10	MA has occurred
11	DCL has occurred
12	Not used
13	Unidentified
14	Incomplete handshake has occurred
15	GET has occurred

SET TIMEOUT

Statement Format:

STMT NUMBER GPIB.RET%=FN.SET.TIMEOUT%(TIME)

Parameters: TIME is the desired maximum time (binary) to wait for all devices to respond to bus transactions (in msec).

Options: None

Purpose: Used to initially specify the max time in a program, or to temporarily change the time to allow for an extremely slow device response.

Return Code: Not used

Notes: The **ABORT.GPIB** (or **INIT.GPIB**) command will reset the maximum timeout to a default value which is specified in the primitives of 5 seconds.

LOCAL LOCKOUT

Statement Format:

STMT NUMBER GPIB.RET%=FN.LOCAL.LOCKOUT%

Parameters: None

Options: None

Purpose: To enable the local lockout feature of the GPIB (a universal command).

Return Code: GPIB.RET% will equal 0 if the command executed properly; otherwise one or more error bits will be set as follows:

BIT	
0	NPC-864MSTWC is not the active controller
1	Not used
2	Timeout

Notes:

1. Setting REN false (i.e., LOCAL with null address list) will disable **LOCAL LOCKOUT** state.

CONFIGURE

Statement Format (Type on one line):

STMT NUMBER GPIB.RET%=FN.CONFIGURE(TALK ADDRESS , LISTEN ADDRESS LIST)

Parameters: TALK ADDRESS is an ASCII string which specifies the data output device. (See format for "ADDRESS" in Section 13.6.1)

LISTEN ADDRESS LIST is an ASCII string which specifies which bus devices are to receive data from the talking device. (See the format for ADDRESS LIST in Section 13.6.1.)

Options: None

Purpose: To configure the GPIB to transfer data between devices on the bus without having the controller handle the data, thus optimizing the transfer rate and freeing the controller for other duties.

Return Code: GPIB.RET% will equal Ø if the command executed properly; otherwise one or more error bits will be set as follows:

BIT	
0	Not active controller
1	Not used
2	Timeout
3	Invalid ADDRESS format

Notes:

1. After configuring the GPIB TALKER and LISTENERS, ATN is set false, which will initiate data transfer. The **EOI STATUS** command should then be used to detect the end of this data transfer (if necessary).

EOI STATUS

Statement Format (Type on one line):

STMT NUMBER GPIB.RET%=FN.EOI.STATUS%

Parameters: None

Options: None

Purpose: To detect end of data transmission between devices set-up by a **CONFIGURE** statement.

Return Code: GPIB.RET% will equal 0 if EOI has not occurred, and 8 if it has occurred.

Notes:

1. This command should only be used after a **CONFIGURE** has been executed. The GPIB interface could possibly be left in an unknown state if executed at other times.

SENDBUS

Statement Format (Type on one line):

STMT NUMBER GPIB.RET%+FN.SEND.BUS%
(COMMAND/DATA STRING)

Parameters: COMMAND/DATA STRING contains the combined command and data to be output by the controller. Two characters are used to control output type (command or data). A colon signifies the switch to COMMAND output (ATN true) and a semicolon signifies the switch to DATA output (ATN false). For example; the string ":?(;WAKE UP:6*;START" would have this effect:

:	set ATN
?	send UNL
(	send LISTEN ADDRESS 8
;	set ATN false
WAKE UP	data sent to address 8
:	set ATN
6*	send listen address 22 and 10
;	set ATN false
START	data sent to address 8, 10 & 22

Options: None

Purpose: Generation of flexible command/data output structures when the NPC-864MSTWC is the bus controller.

Return Code: GPIB.RET% will equal Ø if the command executed correctly; otherwise one or more error bits will be set as follows:

BIT	
0	Not active controller
1	Not used
2	Timeout
3	Not used
4	NPC-864MSTWC is not a TALKER

TERMINATION SEQUENCE

Statement Format:

STMT NUMBER GPIB.RET%=FN.TERM.SEQ%(DATA)

Parameters: DATA contains the desired ASCII sequence to signify end of data string on **OUTPUT** and **ENTER.**

Options:
1. DATA = NULL (CR/LF is used)
2. DATA = "E" (EOI is forced on the last data byte.)
3. 1st character of DATA = ":" will force EOI on last byte of termination sequence.

Purpose: Definition of alternate data terminators for **OUTPUT** and ENTER

Return Code: Not used

Notes:
1. **ABORT.GPIB** (or **INIT.GPIB**) will reset the termination sequence to CR/LF.

13.6.1 ADDRESS/DATA FORMATS FOR CBASIC

FUNCTION	C*	D*	Statement Format
Initialize	X	X	GPIB.RET% = FN.ABORT.GPIB%
Abort/Take Control	X		GPIB.RET% = FN.ABORT.GPIB%
Device Clear	X		GPIB.RET% = FN.RESET%("")
Selected Device Clear	X		GPIB.RET% = FN.RESET%(ADDRESS.LIST$)
Go To Local-All	X		GPIB.RET% = FN.LOCAL%("")
Go To Local-Device	X		GPIB.RET% = FN.LOCAL%(ADDRESS.LIST$)
Set NPC-864MSTWC To Local			X
Lock NPC-864MSTWC In Local			
Remote Enable	X		GPIB.RET% = FN.REMOTE%("")
Set Device to Remote	X		GPIB.RET% = FN.REMOTE%(ADDRESS.LIST$)
Device Status	X		DUMMY.VARIABLE$ = FN.STATUS$(ADDRESS)
Configuration Status	X		STATUS.VARIABLE$ = FN.STATUS$("")
Bus Status	X	X	STATUS.VARIABLE$ = FN.STATUS$("B")
Group Execute Trigger	X		GPIB.RET% = FN.TRIGGER%(ADDRESS.LIST$)
Request Service		X	GPIB.RET% = FN.REQUEST%(STATUS.BYTE%)
Output Data	X		GPIB.RET% = FN.OUTPUT%(ADDRESS.LIST$,DATA$)
Output Data		X	GPIB.RET% = FN.OUTPUT%("",DATA$)
Input Data	X		DATA.VARIABLE $ = FN.ENTER%(ADDRESS$)
Input Data	X	X	DATA.VARIABLE $ = FN.ENTER%("")
Local Lockout	X		GPIB.RET% = FN.LOCAL.LOCKOUT%
Set Timeout	X	X	DUMMY% = FN.SET.TIMEOUT%(TIME%)
Configure	X		GPIB.RET% = FN.CONFIGURE%(ADDRESS$, ADDRESS.LIST$)
EOI Status	X		GPIB.RET% = FN.EOI.STATUS%
Sendbus	X		GPIB.RET% = FN.SEND.BUS%(COMMAND.DATA$)
Termination Sequence	X	X	GPIB.RET% = FN.TERM.SEQ%(TERM$)

***NOTE:** C - CONTROLLER mode
D - DEVICE mode

ADDRESS$

The primary GPIB bus address (range 00-30) of 1 bus device can be followed by any number of secondary commands (range 00-31). A "." is used to separate each address/command.

Examples: 25
12.15
04.31.09

ADDRESS.LIST$

Up to 15 GPIB devices can be specified, using the format for address$. Device addresses are separated by a ",".

Examples: 12.15,04.31.09
23
10,15,20,25

DATA$

Output data string to device(s). Can be any valid ASCII expression.

DATA.VARIABLE$

Name of ASCII variable which will contain data after an **ENTER**.

STATUS.BYTE%

A byte which is returned to the controller in response to a serial poll. Setting bit 6 will set SRQ to request service from the controller.

STATUS.VARIABLES

For FN.Status$("") this variable will be 31 characters long, each character corresponding to a bus address, 0-30, where:

N=No device present
P=Device present
S=Device has requested service

For FN.Status$("B") the character positions are defined as follows:

1. My address (in binary)
2. Address status (used primarily when NPC-864MSTWC is bus device)

   BIT: 0-TADS or TACS (addressed to talk)
   1-LADS or LACS (addressed to listen)
   4-ATN is true
   5-LLO is on
   6-In remote state

3. TALK/LISTEN/CONTROL Status

   BIT: 0-Device mode
   1-Active/System controller
   2-Controller enabled
   3-Listen enabled
   4-Talk enabled

13.6.2 CBASIC RESERVED IDENTIFIERS

These identifiers should not be used in application programs as they are used in the GPIB software interface.

RESERVED VARIABLE IDENTIFIERS:

CMD.GPIB%
GPIB.RET%
T.GPIB%
T.GPIB$

RESERVED FUNCTION IDENTIFIERS:

FN.ABORT.GPIB%
FN.CALL.GPIB%
FN.CONFIGURE%
FN.ENTER$
FN.EOI.STATUS%
FN.GPIB.ASM%
FN.INIT.GPIB%
FN.LOCAL%
FN.LOCAL.LOCKOUT%
FN.MAXGPIB.TIME%
FN.OUTPUT%
FN.PARM.LOC%
FN.REMOTE%
FN.REQUEST%
FN.RESET%
FN.SEND.BUS%
FN.SET.TIMEOUT%
FN.STATUS$
FN.TERM.SEQ%
FN.TRIGGER%

13.7 DIRECT USE OF GPIB PRIMITIVES

1. Before calling a command, these locations must first be loaded with the appropriate data:

E000	LSB of starting address of GPIB ADDRESS LIST
E001	MSB of starting address of GPIB ADDRESS LIST
E002	LSB of starting address of DATA string
E003	MSB of starting address of DATA string
E006	Command Branch Index
E007	Command Control Word

2. Execute a call to location F842 HEX.

3. After execution, the return code will be in locations E008 (LSB) and E009 (MSB).

4. Only the stack is preserved, registers are destroyed.

Notes: a) See Section 13.7.1 for data formats of each parameter in 1, above.

b) For the **REQUEST** command, the binary data is passed in place of the DATA string address.

13.7.1 ADDRESS/DATA FORMATS FOR ASSEMBLER PRIMITIVES

ADDRESS:

First location is length of ADDRESS LIST (1-255). Each subsequent location contains a TALK, LISTEN or secondary address.

BIT	
4-0	Binary Device Address
6-5	Address Type: 01 = LISTEN 10 = TALK 11 = Secondary

All commands can use any combination of LISTEN and secondary addresses, except for **ENTER** and **STATUS**, which can have one TALK address and any number of secondary addresses.

DATA (OUTPUT/ENTER)

Two data string modes are available (bit 0 of the command control byte selects which mode): BYTE or WORD. In the BYTE mode, the first location is used as the string length. In the WORD mode, the first 2 locations are used to form a 16-bit-word length (LSB first), thus allowing a 0-65535 character string length. For the **ENTER** command, the string length before execution will be used as the maximum length.

DATA (BUS STATUS)

The first location contains the string length, which is always 3. The next location contains MA, in binary. The third location contains MA status.

BIT	
0	Addressed to TALK (TADS or TACS)
1	Addressed to LISTEN (LADS or LACS)
4	ATN is true
5	LLO is active
6	In remote state

This location is primarily of interest when the NPC-864MSTWC is a bus device. The fourth location contains the system mode.

BIT	
0	Device
1	Controller
4-2	TLC Mask

COMMAND BRANCH INDEX

A binary number of the index of the command selected from the Branch Table

0 = Abort/Init
1 = Selected Device Clear (alternate command is Device Clear)
2 = Go To Local (alternate command sets REN false)
3 = Local-Lock
4 = Go To Remote (alternate command sets REN true)
5 = Device Status
6 = Bus Status
7 = Trigger
8 = Request
9 = Output
10 = Enter
11 = Local Lockout
12 = Configure
13 = Sendbus
14 = EOI Status
15 = Set Termination Sequence

COMMAND CONTROL BYTE

BIT	DEFINITION
0	0 = Byte Mode; 1 = Word Mode
1	0 = Listen Address; 1 = Talk Address
2	Address conversion required
3	Alternate command select (equivalent to NULL address mode of CBASIC command description)
5-4	Required controller status: 00 = Don't Care 01 = Must be device 10 = Must be controller 11 = Must be controller if alternate command is not selected
6	Must be LISTENER
7	Must be TALKER

RETURN CODE

BIT	DEFINITION (See below for exceptions)
0	Incorrect controller status
1	NPC-864MSTWC is device and not addressed to TALK/LISTEN
2	Timeout
3	Not used
4	Not a TALKER/LISTENER
5	Input data has been truncated to length of data string

BIT	DEFINITION FOR BUS STATUS
0	REN is true
1	IFC is true
2	SRQ is true
3	EOI is true
4	NRFD is true
5	NDAC is true
6	DAV is true
7	ATN is true
8	IFC has occurred
9	SRW has occurred
10	MA has occurred
11	DCL has occurred
12	Not used
13	Unidentified command has occurred
14	Incomplete handshake has occurred
15	GET has occurred

FOR ABORT.GPIB: 0 = Controller
1 = Device

FOR EOI STATUS: Ø = EOI has not occurred
8 = EOI has occurred

FOR DEVICE STATUS: The device status byte (STB) will be in the MSB of the return code

3.8 LEVEL OF GPIB IMPLEMENTATION

The following table provides a summary of the level of implementation of those functions described in the document: ANSI/IEEE std. 488-1978.

Identification	Description	Notes
SH1	Source Handshake	
AH1	Acceptor Handshake	
T6	Talker	TØ when TALK is off
TEØ	Extender Talker	
L4	Listener	LØ when LISTEN is off
LEØ	Extender Listener	
SR1	Service Request	
RL1	Remote Local	
PPØ	Parallel Poll	
DCØ	Device Clear	
DTO	Device Trigger	
C1	Controller	CØ when DEVICE
C2	Controller	CØ when DEVICE
C3	Controller	CØ when DEVICE
C4	Controller	CØ when DEVICE
C27	Controller	CØ when DEVICE

14.0 EXTERNAL CONTROL OF THE NPC-800

The NPC-864MSTWC can be controlled through three "ports:" RS-232, IEEE-488, or the internal CP/M operating system. The NPC-848S, NPC-816T, and NPC-864ST can only be controlled through their IEEE-488 port.

To the NPC-864MSTWC's CP/M operating system, the internal analysis functions, as a group, look like a device on the IEEE-488 bus. This group of functions is accessed by simply using the correct port address in the CBASIC OUTPUT and ENTER functions. The same commands are used for all three ports.

14.1 COMMAND FORMATS

14.1.1 MENU COMMANDS

External commands to the NPC-800 follow the same format and sequence as used when commanding the NPC-800 from the keyboard. ASCII characters are used for all commands. The actual definition of each ASCII character depends on the menu that is currently being displayed. See Section 7.1.4 for soft-key definitions and Table 14-1 for command formats and field definitions.

14.1.2 BUS COMMANDS

In addition to the MENU COMMANDS, a set of BUS COMMANDS is available to enhance the external control features of the NPC-800. See Table 14-2 for a summary of these commands.

14.1.3 IEEE-488 (GPIB)

For GPIB operation, command strings are limited to 80 bytes. All command strings must end in the correct termination sequence (which is programmable in the NPC-800). Only one BUS COMMAND is allowed in a command string, and it must be the last one specified. For burst commands, the data must follow the command string termination sequence. There are no limits to the length of the data portion of a burst command.

14.1.4 RS-232 (NPC-864MSTWC ONLY)

There are no restrictions for command sequences when using the NPC-864MSTWC's RS-232 interface. Commands are executed as they are input. The only requirements for RS-232 operation are that the electrical interface be set up in accordance with the pin definitions in Section 12.3.1 and that the Baud rate be matched between the NPC-864MSTWC and the terminal.

For non-ASCII control formats, use the conversion table in Section 7.1.1.

The following commands enable the NPC-864MSTWC to be controlled remotely from an RS-232 terminal:

NPC-864MSTWC Key	Remote Command
S1	CNTL Q
S2	CNTL R
F1	CNTL S
F2	CNTL T
F3	CNTL U
F4	CNTL V
F5	CNTL W
F6	CNTL X
SCREEN DUMP	U or Z

14.1.5 COMMANDS THAT RETURN DATA

Table 14-3 contains a summary of all commands which return data from the analyzer. Note that some commands are returned as several strings of ASCII characters on the IEEE-488 bus, each terminated with a Carriage Return/Line Feed. Data are ASCII-encoded HEX: therefore the number of characters transmitted will be twice the number of data bytes shown in Table 14-3.

Table 14-1. Command Formats and Field Definitions.

Format Number	Format	Field Definitions
1	A CRLF	Keyboard Commands
2	A CRLF	Bus Commands
3	A HXHX CRLF	Address
4	A HXHX DDDD CRLF	Number of Hex Pairs Address
5	A HXHX HX CRLF	Data Address
6	A CRLF AAA... CRLF	ASCII Data

NOTE: For the NPC-864MSTWC, CRLF is the GPIB termination sequence and is not used on RS-232 commands. The termination sequence is transmitted automatically by the NPC-864MSTWC each time an FN.OUTPUT function is executed from CBASIC.

HX = Hexadecimal Pair (i.e., ØF)
D = Decimal Digit
A = ASCII Character

Table 14-2. NPC-800 Command List (Other than Keyboard Commands)

Command	Description	Format Number
0	Initialize All	2
1	Initialize Logic Analyzer (excluding I/O menu)	2
2	Lock Keyboard	2
3	Unlock Keyboard	2
4	Clear CRT	2
5	CONFIGURATION LIST	2
6	CONFIGURATION LIST-SELECT 48 (32) CHANNEL STATE	2
7	Not Used	2
8	Not Used	2
9	Collect	2
A	Read State Setup	*6
B	Read State Data to Aux Memory	*6
C	Same as above.	*6
D	Read Timing Setup	*6
E	Read Timing Data to Aux Memory	*6
F	Same as above.	*6
G	Dump State Setup	2
H	Dump State Data	2
I	Dump State Aux	2
J	Dump Timing Setup	2
K	Dump Timing Data	2
L	Dump Timing Aux	2
M	Dump Collection Status	2
N	Dump Signatures	2
P	Dump Collection Variables	2
Q	Dump State Probe A Data	4
R	Dump State Probe B Data**	4
S	Dump State Probe C Data	4
T	Dump Timing Data	4
U	Dump Screen to RS-232 Device**	
V	Dump Byte from Memory to Output Device	3
W	Write Byte to Memory from Input Device	5
X	Set CRT Cursor Position	3
Y	Write to CRT From Input Device	*6
Z	Dump Screen to CRT of Remote NPC-864MSTWC over RS-232**	

* Burst Commands
** Available only on NPC-864MSTC.

Table 14-3. Command Formats

NOTE: Each logic analyzer byte below (8 bits) is divided into two 4 bit nibbles. An ASCII equivalent byte is then sent for each nibble.

Input Command	Output Command	String #	Length (Bytes)	Description
A	G	1	713	State Setup and Configuration
B	H	1	413	State Setup
		2	12	State Display Parameters
		3	6144	State Data
C	I	1	413	State Aux Setup
		2	12	State Aux Display Parameters
		3	6144	State Aux Data
D	J	1		Timing Setup
E	K	1		Timing Display Parameters
		2		Timing Display Parameters
		3		Location of First Data Word
		4		Collection Status
		5		Timing Data
F	L	1		Timing Aux Display Parameters
		2		Timing Aux Display Parameters
		3		Timing Aux Display Status
		4		Timing Aux Data
	M	1	2	Collection Status
	N	1	20	Test Codes: 6 - State 4 - Timing 6 - Aux State 4 - Aux Timing
	P	1	8	2 - State Trigger Displacement 2 - State Word Count 2 - Timing Trigger Displacement 2 - Timing Word Count
Q	HXHXDDDD	1	DDDD	State Probe A MSB
		2	DDDD	State Probe A LSB
R	HXHXDDDD	1	DDDD	State Probe B MSB
		2	DDDD	State Probe B LSB
S	HXHXDDDD	1	DDDD	State Probe C MSB
		2	DDDD	State Probe C LSB
T	HXHXDDDD	1	DDDD	Timing Probe A
		2	DDDD	Timing Probe B

14.2 COMMAND DEFINITIONS

The following definitions apply to the NPC-864MSTWC commands you can execute from an external controller. The controller can be another NPC-864MSTWC, a dedicated GPIB CONTROLLER, or an RS-232 terminal. If the controller is another NPC-864MSTWC, the TRANSMIT field of the controller's I/O menu must be ON to avoid local response to commands. (See Table 14-1 for command formats.)

0 - Initialize All of NPC-800

This command performs the same function as a power-up reset. All analysis parameters and data are reset, the CP/M operating system is reset, and the GPIB bus is also reset (Interface Clear is set).

1 - Initialize Analyzer

This command performs the same functions as the 0 command, except for the CP/M operating system and the GPIB bus. Thus, this command can be sent to the internal analyzer from a CP/M program to initialize only the analyzer and leave the rest of the system intact.

2 - Lock Keyboard

This command will set a flag which prevents access to the NPC-800 by unauthorized users at the keyboard.

NOTE: The slave NPC-864MSTWC keyboard cannot be locked while in the I/O menu on the master. The user can only execute this function from CP/M or while in the analyzer proper (menu's or data display).

3 - Unlock Keyboard

This command will reset the Lock Keyboard flag and restore keyboard access.

4 - Clear CRT

This command will cause the NPC-800 to blank its CRT. It is normally used in conjunction with the Y command to send messages to an operator when the NPC-800 is under automatic control.

5 - CONFIGURATION LIST

This command provides a convenient method of calling the NPC-800's Configuration List.

6 - CONFIGURATION LIST-SELECT 48 (32) CHANNEL STATE

This command calls the Configuration List and sets the cursor at the 48 (32)-CHANNEL STATE mode.

7 - NOT USED

8 - NOT USED

9 - COLLECT

This command has the same function as the **COLLECT** key, but can be executed from any menu.

A - READ STATE SETUP

This command is used to read data into the state menu.

B,C - READ STATE DATA

These commands are used to read data into the State Aux Memory.

D - READ TIMING SETUP

This command is used to read data into the timing menu.

E,F - READ TIMING DATA

These commands are used to read data into the Timing Aux Memory.

G - DUMP STATE SETUP

This command is used to dump the State Analyzer's setup.

H - DUMP MAIN STATE DATA

This command is used to dump the State Analyzer's Main Memory Data.

I - DUMP AUX STATE DATA

This command is used to dump the State Analyzer's Aux Memory Data.

J - DUMP TIMING SETUP

This command is used to dump the Timing Analyzer's setup.

K - DUMP MAIN TIMING DATA

This command is used to dump the Timing Analyzer's Main Memory Data.

L - DUMP AUX TIMING DATA

This command is used to dump the Timing Analyzer's Aux Memory Data.

M - DUMP COLLECTION STATUS

This command is used to dump the Analyzer's Collection Status. If not collecting, then dump one byte for the State Analyzer and one byte for the Timing Analyzer.

N - DUMP SIGNATURES

Dump Signatures (20 bytes): A,B,C, Main State Memory; A,B, Main Timing Memory; A,B,C, Aux State Memory; and A,B, Aux Timing Memory Signatures.

O - NOT USED

This command is not used.

P - DUMP COLLECTION VARIABLES (16 bytes)

This command provides a State Word Count (4 bytes) and a Trigger Displacement (4 bytes); a Timing Word Count (4 bytes) and a Trigger Displacement (4 bytes).

QXXXXYYYY - DUMP STATE A PROBE DATA

This command is used to dump the State A Probe data with most significant bytes followed by least significant bytes, where XXXX = start of dump displacement from first word collected and YYYY = word count to dump.

RXXXXYYYY - DUMP STATE B PROBE DATA

See Q command above.

SXXXXYYYY - DUMP STATE C PROBE DATA

See Q command above.

TXXXXYYYY - DUMP TIMING A & B PROBE DATA

This command dumps A Timing Probe data bytes followed by B Timing Probe data bytes. See Q command above.

U - DUMP SCREEN TO RS-232 DEVICE*

Vaaaa - SINGLE BYTE MEMORY DUMP

This command is used to dump the byte at HEX address to enabled output ports.

Waaaabb - SINGLE BYTE MEMORY WRITE

This command writes byte bb to address aaaa.

---

*Only on NPC-864MSTC.

Xpppp - SET SCREEN CURSOR POSITION

This command is used to set cursor position to relative value pppp in decimal (0-1999).

Ydddd..dd$ - WRITE TO SCREEN

This command is used to write data ddd... to the screen cursor location. Terminate data with $. Screen RAM begins at F000(HEX) and ends at F7CF(HEX).

Z - SCREEN DUMP TO REMOTE NPC-864MSTWC

This command is used to dump a CR and a LF followed by the first 25 lines of the screen to the RS-232C port, if enabled.

14.3 TRANSMISSION EXAMPLES (NPC-864MSTWC ONLY)

The purpose of these examples is to demonstrate the use of the I/O CONFIGURATION MENU of the NPC-864MSTWC.

14.3.1 RS-232 INTERFACE

In this example, the NPC-864MSTWC will communicate with another device over the RS-232 interface. The device should be capable of displaying and transmitting ASCII data (such as a data terminal).

SET-UP

Connect the NPC-864MSTWC to the terminal using the RS-232 interface at the rear of the analyzer. Ensure the terminal is configured as follows:

BAUD RATE:	1200
PARITY:	NONE
DUPLEX:	HALF
WORD LENGTH:	8
STOP BITS:	1

NOTE: If settings on the terminal are not easily changed, the NPC-864MSTWC's parameters can be changed instead using the RS-232 section of the I/O CONFIGURATION MENU.

Press the **RESET** key and hold it down for at least two seconds to call the CONFIGURATION LIST. Select the I/O CONFIGURATION MENU by pressing the I key. Make sure the RS-232 INTERFACE field is ENABLED. Advance the blinking cursor to the KEYBOARD field by pressing the **I (INPUTS)** key. Press the **SELECT** key to enable keyboard inputs to be transmitted when pressed. Use the **NEXT** and **SELECT** keys to turn the RS-232 INPUT field ON to enable the NPC-864MSTWC to receive data over the RS-232 interface. Advance the cursor to the CRT field by pressing the **O (OUTPUTS)** key. Press the **SELECT** key to turn this field ON, enabling the CRT to display input data. Move the blinking cursor to the RS-232 OUTPUT field by pressing the **NEXT** key. Press the **SELECT** key to turn this field ON to enable transmitting data over the RS-232 interface. See Figure 14-1.

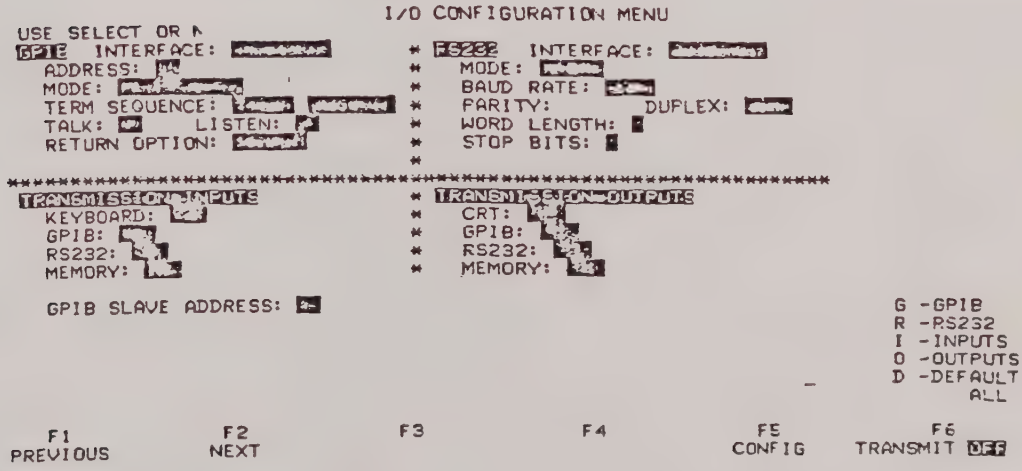

Figure 14-1. Using the I/O CONFIGURATION MENU to transmit keystrokes to another device such as a terminal.

TRANSMIT

Press the **TRANSMIT (F6)** key. The **TRANSMIT** key label will change to ON to indicate that transmission and reception are enabled. Type a few characters on the NPC-864MSTWC keyboard. Note that the characters appear on the CRT of the NPC-864MSTWC, as shown in Figure 14-1, and on the printer or CRT. Now type a few characters on the terminal keyboard. Note that the characters appear on the CRT of the NPC-864MSTWC.

Press the **TRANSMIT** key again. The key label will now change to OFF. Check the RS-232 MODE field. It should be set to SLAVE. (If not, use the **R**, **NEXT**, and **SELECT** keys to call the SLAVE mode.) Type **CTRL T** on the terminal's keyboard and note that the blinking cursor moves to the next field. (**CTRL S** moves the cursor to the previous field.) Type an R on the terminal keyboard and note that the cursor moves to the RS-232 INTERFACE field. In this mode, data or keystrokes from the terminal are executed by the NPC-864MSTWC as if the keys on its own keyboard were being pressed.

14.3.2 ANALYZER DATA TRANSMISSION

In this example, the transfer of blocks of analyzer data from one NPC-864MSTWC to another will be demonstrated. The example will use the GPIB bus, but the RS-232 bus may also be used.

SET-UP

Connect one NPC-864MSTWC to another NPC-864MSTWC using the GPIB bus connectors at the rear of each unit. (Disconnect the RS-232 cable to avoid possible noise problems.)

For both units, perform the following sequence: Turn the power switch on or press **RESET** to produce the CONFIGURATION LIST. Then press the I keys to call the I/O CONFIGURATION MENUS.

CONTROLLER (MASTER)

For the unit selected to be the CONTROLLER, the I/O menu will be set up in the following steps with the default values in all fields except GPIB INTERFACE (ENABLED), GPIB MODE (CONTROLLER), MEMORY INPUT (TIMING SETUP), and GPIB OUTPUT (ENABLED). After making sure that the GPIB INTERFACE field is enabled, advance the cursor to the GPIB mode field using the **NEXT** key. If the field is set to DEVICE, press the **SELECT** key to set it to CONTROLLER. Access the TRANSMISSION INPUT field by pressing the I key. Then advance the cursor to the MEMORY field by pressing the **NEXT** key. Press the **SELECT** key twice to set the memory to TIMING SETUP. Then use the O key and the **NEXT** key to access the GPIB OUTPUT field. Use the **SELECT** key to turn this field ON.

Press the **CONFIG** key to call the CONFIGURATION LIST. Select the 16-CHANNEL TIMING mode by pressing the **SEL DOWN** key. Call the menu with the **TIMING** key. Arbitrarily change two or three of the parameters in the menu.

Press the **CONFIG** key to call the CONFIGURATION LIST again. Select the I/O CONFIGURATION MENU by pressing the I key. At this point, the first NPC-864MSTWC (CONTROLLER) is ready to send the timing menu to the second NPC-864MSTWC (DEVICE) over the GPIB bus. See Figure 14-2.

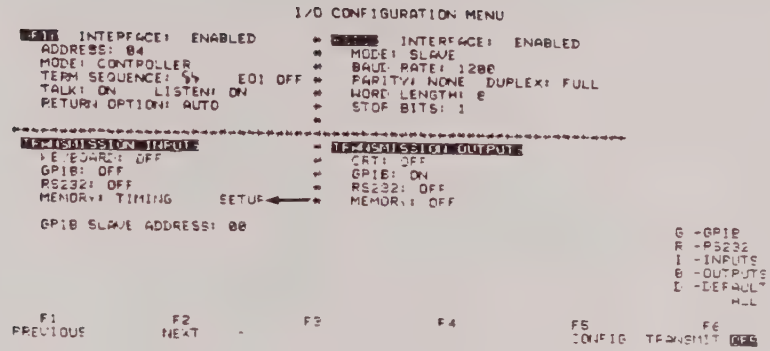

Figure 14-2. I/O menu for transmitting the timing menu to an NPC-864MSTWC, acting as a DEVICE on the GPIB bus.

DEVICE (SLAVE)

For the NPC-864MSTWC acting as a DEVICE, the I/O menu should be set up as shown in Figure 14-3. Note that DEVICE is selected, the DEVICE ADDRESS is set to 00* (using the **SELECT** key), and the GPIB INPUT field is ON. At this point, the second NPC-864MSTWC is ready to receive the timing menu over the GPIB bus.

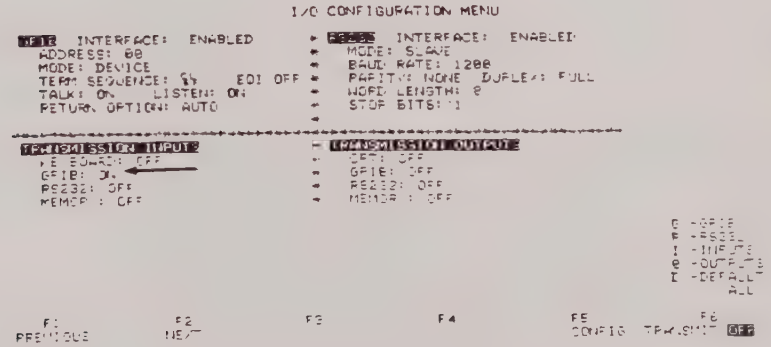

Figure 14-3 I/O menu for receiving the timing menu from another NPC-864MSTWC.

---

*30 device addresses are available.

Now go back to the NPC-864MSTWC you have set up as a CONTROLLER and press the **TRANSMIT** key to turn the field ON. The message DONE will flash on the NPC-864MSTWC acting as a DEVICE when transmission is complete and the TIMING SETUP data has been transferred from the CONTROLLER.

Press the **CONFIG** key on the second NPC-864MSTWC (DEVICE) to get back to the CONFIGURATION LIST. Select the 16-CHANNEL TIMING mode by pressing the **SEL DOWN** key. Call the menu with the **TIMING** key. Note that those parameters that were changed in the CONTROLLER are also changed in the DEVICE.

14.4 MORE I/O EXAMPLES

Your NPC-864MSTWC's diskette contains two CBASIC programs to further illustrate the instrument's GPIB CONTROLLER/DEVICE and RS-232 MASTER/SLAVE capabilities. These programs are called GPIBEX and RS232EX and do not require any programming to use. Through easy-to-use menus, you can control another instrument and transfer data.

SOURCE

The source listings for both programs are available on the diskette by typing: **TYPE GPIBEX.BAS** or **TYPE RS232EX.BAS.** These listings will be of interest to those of you who would like to modify these programs for your own application. (Type **CNTL S** to stop the screening from scrolling; type any key to start.)

14.4.1 GPIBEX

The GPIBEX program allows you to exercise an external GPIB-compatible instrument, or control your NPC-864MSTWC's internal analysis functions. In the example that follows, the internal 48 CHANNEL STATE ANALYZER will be exercised by the CONTROLLER, just as if it were an independent instrument on the GPIB bus:

PROCEDURE

1. Insert the diskette and press **ESC** to call the CP/M operating system. Type **DIR** and **RETURN** to make certain the GPIBEX program is on your diskette. (Contact the factory or your nearest sales office if the program is not on your diskette.)

CRUN2 GPIBEX

2. Type **CRUN2 GPIBEX (RETURN).** After a short delay, when the main menu is displayed, select the LOGIC ANALYZER COMMAND MENU (option 2) as shown in Figure 14-4.

```
MAIN MENU:

                    1  GPIB COMMAND MENU
                    2  LOGIC ANALYZER COMMAND MENU
                    3  SET MAX. TIMEOUT
                    4  SET TERMINATION SEQUENCE
                    5  SET DEVICE ADDRESS
                    6  QUIT

-

SELECT OPTION
```

Figure 14-4. MAIN MENU.

COMMAND MENU

3. After pressing **RETURN**, the LOGIC ANALYZER COMMAND MENU will be displayed. Select the option: SEND COMMAND TO LOGIC ANALYZER (option 1) as shown in Figure 14-5.

```
LOGIC ANALYZER COMMAND MENU:

                    1  SEND COMMAND TO LOGIC ANALYZER
                    2  SEND SOFT-KEY COMMAND TO LOGIC ANALYZER
                    3  GO TO LOGIC ANALYZER
                    4  LASAVE
                    5  LARECALL
                    6  GO TO MAIN MENU

SELECT OPTION
```

Figure 14-5. LOGIC ANALYZER COMMAND MENU.

NOTE: Selecting option 1 automatically sets the device address for the NPC-864MSTWC's internal analysis functions.

---

4. Press **RETURN** to call the header: ENTER COMMAND STRING.

NOTE: In this program, you can only enter in one command or menu field set-up at a time. See Section 14.1 and 14.2 for command formats and definitions. Be careful to use correct formats; otherwise the software may return you to the analyzer operating system (or possibly crash) and you'll have to repeat the above procedure from step 1.

---

5. Type **1 (RETURN)** to initialize the analyzer and display the CONFIGURATION LIST. Then press **RETURN** to call the command menu, as indicated by the message on the bottom of the CRT.

6. Select option 2 to send a soft-key command and press **RETURN.** When the header: SELECT SOFT-KEY (1-6) appears, type **1** to select the F1 **(STATE)** function which calls the state menu.

STATE MENU

7. At this point, observe that the state menu is displayed with the cursor in the FORMAT field. Now call the command menu and type **1** and **RETURN.** When the command string header appears, type in 16 **A's,** 16 **B's,** and 16 **X's.** See Figure 14-6. Next, press **RETURN.**

```
ENTER COMMAND STRING AAAAAAAAAAAAAAAABBBBBBBBBBBBBBBBXXXXXXXXXXXXXXXX
```

Figure 14-6. Setting up the State Format Field.

8. Notice that the state menu carries out the format command as soon as **RETURN** is pressed. Suppose you wanted the A and B FORMAT fields to be set to hexadecimal and binary, respectively. To accomplish this, call the command menu, select option 1, and simply type: **HN.**

TRIG

9. Next, trigger word will be set up. (The rest of the menu will be unchanged.) To set down to the TRIGGER field, command the **F2 (NEXT)** key 5 times. (Call the command menu, type **2 (RETURN),** and type **2** again **(RETURN).** Repeat until the cursor is in the TRIGGER field.)

10. For this example, we will use the trigger word 0040. Call the command menu, type **1,** and type **0040 (RETURN).** See Figure 14-7.

```
                    48 CHANNEL STATE MENU

FORMAT:  AAAAAAAA AAAAAAAA BBBBBBBB BBBBBBBB XXXXXXXX XXXXXXXX
           A HEX  B BIN
CLK SEL:  A PRB: 1  B FPB: A  C PRB: A    QUALIFIERS: -AABBCC EL
CLK QUAL: OFF
      OR  OFF
  PRE-TRIG MEMORY (0-999): 862 WORDS
RESTART:  OFF
TRIGGER:
 0        0240 XXXXXXXXXXXXXXXX -XXXXXX XX
 END

                                                  H - HEX
                                                  O - OCTAL
                                                  D - DEC
                                                  N - BINARY
                                                  Y - ASCII

PRESS RETURN TO CONTINUE
```

Figure 14-7. The State Menu Set-Up.

COLLECT

11. To take a data collection, first make sure the A state probe is connected to the test card. Then return to the command menu, type **2**, and then type **6** for **F(6) (COLLECT)**. The analyzer will respond initially with no data displayed. To display data, you must command the **F(6) (COLLECT)** key again or select any of the valid display commands. (For example, you can display data by sending a U **(USER** format) command to the analyzer.) See Figure 14-8.

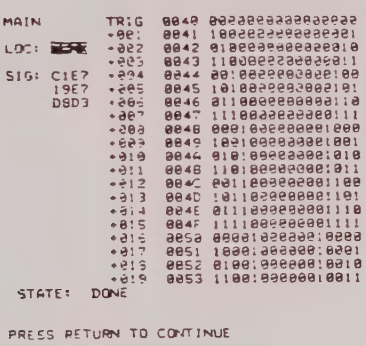

Figure 14-8. Corresponding State Display.

DIRECT

12. Once data are displayed, you can rapidly access a desired field of the state menu by sending a direct entry command, such as P (PRETRIGGER).

NOTE: The S1 or S2 (DATA DISPLAY) function is not available in the GPIBEX program.

You are encouraged to experiment with other portions of the GPIBEX program using the state or other internal analyzer functions of the NPC-864MSTWC. You will also find this program convenient for checking out the operation of external GPIB instruments.

14.4.2 RS232EX

The RS232EX program demonstrates the use of the NPC-864MSTWC's MASTER/SLAVE capability. For this program you'll need two NPC-864MSTWC's tied together via the RS-232C interface.

PROCEDURE

SET-UP

1. Define one NPC-864MSTWC as a MASTER and the other as SLAVE. See Section 12.4 so that the master defaults to "MASTER and the slave to "SLAVE" upon power-on reset. See Section 12.4. Connect an RS-232 male-to-male cable between units. MAKE SURE THAT PINS 2 AND 3 ARE SWAPPED ON ONE END. (Use a break-out box or equivalent.)

CRUN2
RS232EX

2. Press **RESET** and type I for both units. On the unit defined as a SLAVE, make sure that the GPIB INTERFACE field is DISABLED, RS-232 INTERFACE field is ENABLED, and the RS-232 MODE field is set to SLAVE. On the unit defined as a MASTER, set up the I/O CONFIGURATION MENU the same as for the SLAVE, **except make sure the RS-232 MODE field is set to MASTER.** On both units call the CONFIGURATION LIST. Then, for the MASTER, press **ESC** and type **CRUN2 RS232EX.**

3. Connect each NPC-864MSTWC's A state probe to the A input connector on each test card. Make sure both probes are set to TRUE and TTL.

COMPARE
UUT

4. When the MAIN MENU appears, select option **1**, COMPARE UUT DATA WITH "GOLDEN UNIT," and when the LOGIC ANALYZER SETUP MENU appears, select: SETUP DATA WITH SIMPLE TRIGGER. At this point, follow the directions to execute a pre-stored test in both units simultaneously.* The program concludes by comparing test codes to see if the data collections match.

OTHER LOGIC
ANALYZER SETUPS

5. After the program displays the test codes, return to the MAIN MENU, select option 1 again and then experiment with the other logic analyzer setups. (Go back to Step 2 to set up the I/O CONFIGURATION MENU as before.) Option 2 is similar to option 1 except a more complex, multi-level trigger test is executed; option 3 allows you to recall your own, previously-saved file (using LASAVE); and option 4 allows you to use a manually set-up test.

ADDITIONAL RS232EX
TESTS

6. Other RS232EX options are: VIEW/MODIFY LOGIC ANALYZER SETUP, which allows you to manually edit or revise the MASTER's test setup;** SAVE CURRENT SETUP & DATA, allows you to store the revised test on diskette for execution by option 1 (COMPARE UUT DATA WITH "GOLDEN UUT"); and the last option, option 4, which allows you to exit.

***NOTE:** The messages TRANSMITTING and RECEIVING will appear at the appropriate points in each step of the test. Note that it will take several seconds to several minutes, depending on the amount of data and the data rate used, to complete the data transfer between units.

****NOTE:** After editing the logic analyzer menus, call the CONFIGURATION LIST and type R to return to automatic control.

APPENDIX A — GLOSSARY

Acquisition — The process by which input logic signals are compared at a discrete instant to a threshold level and recorded.

Active Clock Edge — The clock transition on which all receivers (listeners) interpret the data on the bus. A logic analyzer must monitor the system using this same active edge as its clock.

Address Bus — That bus in the system used to address or define the memory or device location enabled.

Aliasing — The misleading display of a sampled analog waveform when the sample rate is less than twice the input frequency.

Arm — An input or condition that must occur prior to the analyzer trigger conditions being recognized. See **Trigger Enable.**

ASCII — American Standard Code for Information Interchange; a standard alphanumeric code defining a character set.

Assemble — To combine routines to form a program; to translate a source program into a machine language, usually producing one machine language instruction for each source language instruction.

Assembly Language — A language of mnemonics (resembling English more closely than 1's and 0's) that defines the machine instruction to be executed.

Asynchronous Clocking — Data is clocked into the logic analyzer at a rate unrelated to the system under test. See **Timing Analyzer, Synchronous Data.**

Asynchronous Data — Data that is not referenced to time. The completion of one operation signals the next operation.

Asynchronous Triggering — Triggering of timing analyzer by signals independent of the analyzer clock.

Automatic Test — A capability of some analyzers that allows the storage of a partial or complete test procedure, plus the expected results, in an auxiliary memory. Tests are then executed with minimal user intervention.

Auxiliary Memory — Space in memory in addition to the active recording memory. It may include RAM and PROM and is used in comparing data, halting on difference, automatic testing and other functions.

Baud Rate — The number of symbols per second that are transmitted (a symbol normally consists of one bit.)

Block Transfer — The movement of a group of fields from one group of addresses to another group of addresses.

Bootstrap — The instructions at the beginning of a program together with a few instructions entered from the control console used to load a program into RAM; a minimal-size loader program.

Branch — See **Transfer Command.**

Breakpoint — A point in a program in which a process(or) may be made to stop automatically for a check on the progress of the data handling. See **Emulator.**

Bus System — A network of paths or set of lines that facilitate data flow in a digital system. The common buses are the address, data, and control buses.

Call — To place the necessary initial values of variables in the required addresses and then to transfer control to a subroutine. See **Transfer Command.**

Clock — The pulses that control the timing of operations in a digital system; some systems having more than one clock. Both the system and any monitoring instrument must interpret the data on an active clock edge when all data are valid.

Clock Delay — The number of occurrences of a clock before an event.

Clock Qualifier — Additional logic analyzer inputs that may or may not be displayed that define conditions as to when data may be sampled or displayed. A sample is taken only on an active clock edge provided the clock qualifier conditions are satisfied. See **Active Clock Edge, Sampling.**

Clock Slope — The transition or active edge at which the analyzer samples data. See **Edge Sensitive.**

Combinational Trigger — The pattern of 0's, 1's, and "don't cares" set on all channels that, when matched by the sampled data, causes a trace to commence.

Comparator — A circuit that compares two or more signals and supplies an indication of their agreement or disagreement to initiate some other action.

Compare Data — Any form of display in which a captured data record is manipulated with the data set in an auxiliary memory in such a way as to make differences conspicuous. Two examples: the "exclusive-OR" display and rapid alternation of the display between recording and auxiliary memories.

Compiler — A routine by which a computer can translate a source program into an object program by assembling and copying from other programs stored in a library of routines.

Composite Video — An analog signal containing not only display information but also horizontal and vertical synchronizing pulses, all of standard polarity and size.

Concatenate — To connect or link elements in a series or chain to form a whole.

Conditional Transfer — An instruction that causes the processor either to continue with the next instruction in the original sequence or to change control to some other designated instruction, depending upon the result of some logic operation. See **Transfer Command.**

Contents — The word or field stored at a given address or in a given register.

Control Character — A character embedded in operand data that specifies an operation to be done, such as skip to a new page while printing output data.

Correlation — A comparison function; a figure of merit, indicating the number of similarities relative to the number of differences between two elements.

CR — Carriage Return; a control character used to end an input from a keyboard; refers to the mechanical carriage on a printer returning to begin another line, requiring a finite amount of time.

Cross Compiler — A special utility program allowing compiling of code for a processor which differs from the host.

Cross-Domain Linkage — Linkage between the state, timing, and analog domains. See **State Analyzer, Timing Analyzer.**

CT/SA — Counter-timer/signature analyzer. See **Time Measurements.**

Data Compression — Any display technique intended to reduce the time or effort required to examine an entire data record. The simplest form converts binary words into hexadecimal words. One of the more effective techniques is signature analysis. See **Signature Analysis.**

Data Domain — A domain concerned with the total amount of data that must be collected at every event/time in order to characterize synchronous system behavior. A logic analyzer is a data domain monitoring instrument.

Data Qualified Clocking — Specifying a data pattern that is logically ANDed with the clock, to exclude "non-qualified" clock occurrences.

Data Rate — The clock rate for synchronous systems; it must not exceed the specified maximum clock rate of the analyzer.

Debugger — A program used to facilitate testing of a microprocessor system.

Decision — In computer operations, the processes of detecting the existence of specified patterns of relationships in the data being handled, and of taking alternative courses of action based upon the differences detected. See **Transfer Command.**

Dedicated Probe (Personality Probe) — A probe used to examine a particular microprocessor chip used by clipping over the processor and passively monitoring its state transaction.

Delay — User set for an N-count of selected events. Delay is used to offset in time the position of the final data record with respect to the triggering event. See **Clock Delay, Trigger Delay.**

Demultiplexing (Demux) — The sorting of multiple signals which time-share a signal path into dedicated lines (channels).

Density — Referring to a memory diskette, how closely information is packed on a track.

Diagnostic Routine — A routine designed to locate either a malfunction in a computer system or a mistake in coding.

Disassembly — The reverse of assembly; to convert machine language code into user recognizable mnemonics, usually done with the help of a dedicated personality probe. See **Assembly Language, Dedicated Probe.**

Diskette — A flexible mylar oxide-coated storage device, commonly known as a floppy.

Display Polarity — If a logic one at the probe input is displayed as a logic zero on the CRT, the display polarity is said to be inverted (-). If a 1 at the probe inputs is displayed as such, the polarity is normal (+).

DMA — Direct Memory Access is the transfer of I/O information to memory by bypassing the processor.

Don't Care — A channel that may be in either state "0" or state "1," symbolized "X," thereby not restricting data qualification if used in a qualifier word.

Don't Care Triggering — A triggering condition where all of the trigger bits are don't care. The first data that comes along will be traced.

Edge Sensitive — Response of a system to rising (positive) or falling (negative or trailing) **transitions** as opposed to **levels** of the clock. See **Active Clock Edge**.

Edit — To arrange, rearrange, or arbitrarily alter information, especially in format.

Emulator — Hardware containing a microprocessor that replaces the target system's microprocessor and permits execution and interaction with the user's program.

External Trigger — An active signal or an external logic analyzer input that will start (trigger) the analyzer. See **Trigger**.

Field (in a menu) — One or more adjoining characters treated as a group.

File — A set of records on a common subject and usually organized or ordered on the basis of some combination of items of data uniformly found in all the records of the file, such as a date.

Filter — A circuit that ensures trigger conditions (i.e., Boolean combinations) are satisfied for a minimum time before actually triggering the analyzer.

Flow Chart (diagram) — An analysis technique providing a graphic presentation of a procedure. In programming, a chart setting forth the particular sequences of operations to be done in a computer to handle a particular application.

Format — An arrangement of information on a form, document, or in storage. Configuration of a logic analyzer, e.g., arbitrary labels given to input channels, clock and logic polarities, and display presentation.

Glitch Memory — An auxiliary memory that stores the presence of any glitches between sample periods.

Glitch Triggering — Triggering on a glitch on any specified channel. Usually combined with other logic level requirements on all lines.

Halt on Difference — The trigger caused by any detected difference, when incoming data is continually compared to the contents of an auxiliary memory. See **Hold≠**.

Hold≠ — A trigger mode that causes a logic state analyzer to continually collect data until a difference is detected between main and auxiliary reference memories. The last collection is held for display with differences intensified.

Hold-Time

The time following the active clock edge where the analyzer may sample data. Since many systems do not hold the data past the active clock edge, a logic analyzer should have a zero hold time ideally.

Housekeeping

Computer operations which do not directly contribute to useful data handling—extracting of fields, verifying the identification of the input, etc.; in general, the setup (including initialization) and cleanup operations in a program.

In Circuit Emulation

See **Emulator.**

Independent CLK/TRIG Qualification

The concept of forced acceptance of an otherwise not qualified trigger word; occuring before or after (i.e., displaced from) the clock qualification. See **Clock Qualifier, Trigger Qualifier.**

Initialization

When first powered up, a processor will have a random program counter value so that setting variables and control indicators in a program to their starting values is necessary.

Instruction

A word or field that directs the automatic computer to take a certain action. The instruction usually consists of a command together with one or more operand addresses, which, taken together, cause the computer to act upon the indicated operands.

Intelligent Controller

Refering to GPIB instruments it is the director of any transactions on the bus equipped with a uP.

Interpretive Routine

An executive routine which, during the course of data-handling operations, translates a stored macrocoded program into a machine code and at once performs the indicated operations by means of subroutines.

Interrupt

An external control system used to suspend normal operations and possibly cause new sequences of instructions to be followed.

Inverse Video

A black on white display used to highlight trigger words; or in serial displays, the data received. In formatting an analyzer, it is used to indicate user-definable parameters.

Iterative Loop

A repeated group of instructions in a routine.

Jump

See **Transfer Command.**

Label

An identifier, in either human or machine language, e.g., a magnetic tape label identifying the tape or an address identifying a storage location, or an alphanumeric character representing an input channel.

Latch — A glitch latch detects narrow pulses and stretches them such that they are traced by the clock.

LF — Line Feed. See **Carriage Return.**

Library Routines — A collection of standard and fully debugged programs, routines, and subroutines by means of which many types of problems and parts of problems can be processed or handled.

List — A string with pointers (called links) added to each data element to enable their logical sequence to be different from their physical sequence.

Listener — A device in a digital system that is reading data from the bus.

Load Routine — A routine which causes a computer to transfer object code into RAM storage. See **Bootstrap.**

Lockout — The recognition by the processor of an illegal or impossible triggering requirement. Simplification of the restraining conditions is recommended.

Lookup Table — A memory structure, typically a ROM, where a specific address yields specific yet repetitive data. The process of finding a function in a table when provided with a key and arguments.

Loop — An iterative routine, usually subject to instruction modification in a progressive manner until an exit condition is reached.

Machine Language — Information represented in a form which an automatic computer can handle directly. For example, the result of assembling a symbolic source program is the machine language object code.

Macro, Macrocommand, Macroinstruction — A symbolic command or instruction that is translated into two or more machine language instructions (often an entire subroutine) by the translator program.

MDS — Microprocessor Development System; a system of hardware and software used to develop and help debug microprocessor-based products. See **Emulator, State Analyzer, Timing Analyzer.**

Microprocessor Analyzer — A special logic state analyzer that monitors microprocessor bus systems and displays the results in microprocessor mnemonics. See **Dedicated Probe.**

Microprogram — A basic command repertoire for an automatic computer that consists only of basic elemental operations which the programmer can combine into commands to suit his/her own convenience and in terms of which he/she would then program.

Mnemonic — A set of symbols that combine a series of 0's and 1's, as used by a machine, into symbols that suggest the instruction to a human; e.g., LDA is Load Accumulator.

Monitor — To execute a program under the control of an executive routine; an executive routine capable of controlling the execution of a number of different programs one immediately after the other, including the clean up and restart between each program, thus relieving the operating personnel of some control functions and reducing computer idle time. See **Operating System.**

Multiphase Clocking — Input data is organized as multiple words in width, each word with its own clock input. User may select positive or negative-going edges for each clock — a necessary capability when the analyzer is used with a microprocessor that multiplexes data and address information on the same bus (for example, the Intel 8085).

Multiple Occurrences — Part of the trigger conditions that require the analyzer to find the trigger state a specified number of times in order to completely satisfy the trigger conditions. See **Clock Delay, Trigger Delay.**

Multiplexed — The process of transmitting more than one set of signals over one bus; e.g., address and data information could occur at different times on the one bus. Information on the bus is defined by the control signals.

Negative Logic — Refers to a logic "0" being true; a common misconception is that it refers to negative voltage levels.

Negative Time — Events that occur before the defined trigger conditions are satisfied are said to occur in negative time. See **Pretrigger.**

Nested Loop — A subroutine enclosed within a larger subroutine.

Nibble — Half of a byte.

Nonoccurrence Trigger — In the sequential triggering mode, means trigger, if any word other than B occurs N events after A. It can have meaning for parallel triggering, if the inputs are organized as two words. Then the term means trigger if one word and anything but the other word occur simultaneously. See **NOT Trigger.**

NOP — An instruction causing no change in the processor except a normal increment of the program counter, in other words, to go to the next instruction.

NOT Trigger — A trigger condition that initiates data acquisition any time a state other than the state specified occurs. Also known as nonoccurrence triggering.

Object Program — A program produced by some translation process, as by the use of a compiler routine, from a source program. An object program need not be in a machine language, but often is.

Op Code — The portion of a software instruction set that defines the next operation to be performed. Often extra information (the operand) will be required to define the data or location on which the op code will operate. See **Dedicated Probe, Mnemonic.**

Operand — The part of an instruction to a processor that defines the data or the location to which the op code refers; something acted upon.

Operating System — An executive routine and other supporting programs used to assist and control, in part, the operation of a computer. See **Monitor.**

Parallel Trigger — The event caused by the occurrence of a selected word (or simultaneous occurrence of two words, like address and data) at the inputs. One of the obvious advantages of logic analyzers over conventional analog oscilloscopes.

Parity Check — A type of redundant check in which the evenness or oddness of the number of 1 bits is verified.

Pass Count — See **Clock Delay, Trigger Delay.**

Patch — A correction made to a program and usually inserted into the control sequence by unconditional transfers of control.

Pointer — A means of designating the address or name of something. See **Label.**

Positive True Logic — Refers to a logic "1" being true.

Polling — A technique in which multiple I/O devices time-share an I/O channel without contention.

Post Processing — Processing of data after the collection is complete. For example, determining the number of occurrences of a specific data pattern.

Post-trigger — Positive Triggering. Post-trigger means the captured record consists of data, all or most of which occurred after the trigger.

Pretrigger — Negative Triggering. Pretrigger means that the captured record consists of data, all or part of which occurred before the trigger. It can never be greater than the memory capacity.

Probe — The pod on the logic analyzer that actually connects to the circuit under test. Important criteria are probe loading and speed capability. The mechanical interface to the system under test. A basic probe consists of a ribbon cable terminating in a pod with flying leads. The pod contains input buffers and sometimes other circuitry, which can, for example, set the logic threshold.

Program — A set of in-sequence, coded instructions for a digital computer, sometimes known as a routine or a subroutine.

Program Counter — An essential register in a CPU keeping track of where a program is.

Protocol — The sequence of events or the format of signals or lines that must occur for the correct operation of a system.

Qualifier — An additional input, not necessarily recorded as data, but used to enable the trigger or the analyzer's clock input.

Radix (base) — The fundamental number of a number system, e.g., 10 in the decimal system.

Restart — Used with sequential trigger to restart the trigger sequence should a given state occur; useful when a critical branch is encountered in program flow.

Resolution — The time interval over which a transition displayed by a timing analyzer may have occurred. For a single channel this will be 1 clock period. Between channels, the resolution is ± 1 clock period.

Routine — A program, or a part of a program.

Sample Window — The sample window consists of set-up and hold times and is the time about the sample instant when the analyzer registers data.

Sampling — Examining a voltage at discrete instances in time with the implied assumption that the waveform is constant until the next sample strobing.

Scroll — The rolling or shifting of the logic analyzer display window through the analyzer memory.

Sector — The subdivision of a track on a memory disk. On floppy diskettes two versions are available: hard and soft sectored.

Sector Access Hole — A small hole on the floppy diskette jacket through which the index hole can be sensed by the disc drive timing sensor.

Selective Trace — A data collection where the data sampled is selectively edited before being stored in memory; performed to conserve memory space.

Sequential Trigger — A trigger condition that must be satisfied by a series of states in the specified sequence. The event caused when and only when data word B follows data word A by N selected events. N is usually set by the delay function.

Serial Data Bus — A bus on which the data is all transferred bit-by-bit in a serial manner.

Set-Up Time — The time prior to the active clock edge during which data may be sampled by the analyzer. Therefore, the data must be valid for at least this interval.

Signature Analysis — A technique for data compression, in which the entire data record is compacted into one or more 4-character words through an algorithm that weights each bit equally. For all practical purposes, this signature is unique to the data and may be compared to a known, good signature.

Simulator — A program used in a host computer to test the correctness of machine code. See **Emulator.**

Single Step — To execute a program on a step-by-step basis.

Skew — The difference in the delays across channels as measured between the probe tip and the point when the data is interpreted by the analyzer.

Soft-Key — A key that serves different purposes at different times, as defined by software, and is labeled accordingly.

Source Program — A program that is to be translated to an object program; for example, a program written in a symbolic language.

Stack — A group of storage locations used to temporarily store data, in a modified sequence, according to the last location, unlike a program counter.

State Analyzer — State-sequences of a digital system are recorded for analysis with a logic state analyzer.

Storage Dump — A read-out or printout of the contents of a storage device. Usually only the contents of internal storage are dumped, and usually the read-out is onto magnetic tape or disks, and the printout onto paper via a line printer or typewriter.

Synchronous Analyzer — Traces data which are synchronized with the clock of the system under observation. See **State Analyzer.**

Synchronous Data — Data that coincides or is valid with a defined clock or control signal.

System Clock — Clock signal provided by the system under test.

Table — A listing. See **State Analyzer.**

Talker — A device in the system that is putting data onto the IEEE-488 bus.

Text Editor — A program used to develop and modify source programs, used before translation to an object program.

Threshold — A signal amplitude level that divides one state from a second. A facility that allows the threshold on a logic analyzer to be varied either for different logic families or to check marginal data transitions.

Threshold Adjust — An adjustment control on a logic analyzer used to vary the voltage level that defines what a logic analyzer will interpret as a logic "0" or logic "1." This can be software programable or a hardware adjustment point. See **Variable Threshold.**

Threshold Range — Spread of threshold voltage to accommodate different logic families.

Time Out — If a trigger event does not occur within a preset time, a trigger event will be forced.

Time Measurements — Time measurements with logic analyzers that may be relative (between samples), absolute (from trigger word), or between states and trigger stack levels, or between edges of specific traces.

Timing Analyzer — A timing analyzer monitors the activity of a digital system and presents its observations as a state-time display or a pseudo-waveform of logic levels and transitions.

Trace Programming — To follow the control sequence instruction-by-instruction, usually producing a printout reporting the consequences of each instruction; a routine for doing tracing. A hardware trace is the video display of a logic waveform.

Track — The path on which data is recorded on a floppy diskette, lying directly beneath the read/write head.

Transfer Command — A signal that conditionally or unconditionally specifies the location of the next instruction and directs the CPU to that instruction. See **Conditional Transfer.**

Transfer Rate — The speed of data transmission, usually quoted in characters (baud) or bits per second.

Transient Triggering — Triggering of a timing analyzer on a state that only occurs as a transient. See **Hold≠.**

Trigger — A word, or sequence of words or events, that defines the point where a logic analyzer references its trace to the system activity, the start of a data collection process. To initiate the capture of a data record. Loosely, it may refer to the triggering event. See **Parallel, Sequential, Non-occurence, Pre** and **Post-trigger.**

Trigger Delay — Delay added so that the Nth word past the trigger is recorded by the logic analyzer.

Trigger Disable — A condition or state that cancels the trigger enable. See **Restart.**

Trigger Enable — A state that must occur before the trigger word will be recognized. See **Arm.**

Trigger Output — A synchronizing signal out of a logic analyzer that signifies that trigger conditions are met. It may be used to synchronize external instruments such as oscilloscopes or to arm a second analyzer. See **Comparator.**

Trigger Qualifier — A combinatorial signal (word) that places constraints on satisfying trigger conditions; i.e., the analyzer is triggered only when the specified trigger state **and** the trigger qualifier conditions occur. See **Data Qualified Clocking.**

Utility Routine — A routine to perform functions auxiliary to the running of other programs. Examples are storage dump routines, bootstrap routines, tape label routines.

Variable Threshold — A type of probe that allows user-adjustment of the logic threshold voltage reference. User can adapt the analyzer to different logic families or to test noise immunity. See **Threshold.**

Waveform — A modified timing mode, with an A/D converter as the front-end of the analyzer which performs like a digitizing oscilloscope.